

DOCUMENT RESUME

ED 171 572

SE 027 796

AUTHOR Suydam, Marilyn N.
TITLE Calculators: A Categorized Compilation of References.
INSTITUTION Calculator Information Center, Columbus, Ohio.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Jun 79
CONTRACT 400-79-0025
NOTE 188p.; For related document, see SE 026 880; Contains occasional light type
EDRS PRICE MF01/PC08 Plus Postage.
DESCRIPTORS *Annotated Bibliographies; Calculation; Educational Change; Instructional Materials; Literature Reviews; Mathematics Curriculum; *Mathematics Education; Mathematics Instruction; Research; *Resource Materials; Teaching Techniques
IDENTIFIERS *Calculators; *National Institute of Education

ABSTRACT

This document consists of a list of the references on calculators which were collected by the Calculator Information Center prior to June 1979. Included are references which previously appeared on bulletins distributed by the Center, plus articles from newsletters and similar less readily available sources and from non-American sources. Most references are annotated; all include a limited set of descriptors or keywords which denote the focus or contents of the reference. At the end of the listing is an index for each descriptor. (MS)

 * Reproductions supplied by EDRS are the best that can be made *
 * from the original document. *

ED171572

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

Marilyn N. Suydam

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

Calculators:

A Categorized Compilation of References

Marilyn N. Suydam

BEST COPY AVAILABLE

June 1979

Calculator Information Center
The Ohio State University
1200 Chambers Road
Columbus, Ohio 43220

The work upon which this publication is based was performed pursuant to Contract No. 400-79-0025 of the National Institute of Education. It does not, however, necessarily reflect the views of that agency.

SE 027 796

Table of Contents

	<u>Page</u>
Introduction	ii
List of References	1
Index	155

Calculators: A Categorized Compilation of References

Marilyn N. Suydam

Introduction

Ever since the price of calculators dropped about five years ago, awareness of their potential for use in schools has increased. From March 1977 through June 1979, the Calculator Information Center has met the dual functions of collecting and disseminating information about the use of calculators in education.

This document consists of a list of the references which have been collected by the Center prior to 1 June 1979. The majority of these references have appeared on Reference Bulletins distributed by the Center^{*}; there are also two additional types of materials cited here which did not appear in those bulletins:

- (1) Articles from newsletters and similar sources (which are not readily available to wide audiences), and
- (2) Articles and other documents from non-American sources.

No claim to comprehensiveness is made: readers are encouraged to send additional references to the Center. Omitted are approximately 450 references which pertain to applications which seemed too specialized in intent for use in schools.

The alphabetized listing of references includes, in brackets, a limited set of descriptors or keywords which denote the focus or contents of the reference. At the end of the listing is an index which can help the reader in locating documents of interest. Anyone who has categorized a large number of documents will understand the difficulty of the task. Thus, some descriptors which could have been applied to a particular

reference have not been listed. In some cases, more than one set of descriptors could be checked; for example, many of the citations under "Elementary" involve the use of "Four-function calculators", yet were not assigned that descriptor. Such omissions generally occurred because the descriptor did not (immediately) come to mind as the reference was scanned. It is suggested that readers might add their own notes of studies which are appropriate in each category.

In the majority of instances, the references are annotated. In a small percentage of cases, however, no annotation is included; this occurred most often because the document was not available at the Center. The descriptors should reflect what is known about the contents, as reflected by the title.

It is hoped that this document will be of aid to teachers, to researchers, and to others who need and want references on calculators.

* A complete list of the bulletins and other products of the Calculator Information Center follows:

(1) Reference Bulletins

Reference bulletins have been prepared (by Marilyn N. Suydam), listing current references at periodic intervals. The 24 bulletins are:

- No. 1 Some Selected Articles: Activities with Hand-Held Calculators. April 1977. [2 pages, non-annotated; superseded by Reference Bulletin No. 7]
- No. 2 Research on Hand-Held Calculators. April 1977. [6 pages, annotated; superseded by Reference Bulletin No. 9]
- No. 3 Research on Desk Calculators. April 1977. [5 pages, annotated; superseded by Reference Bulletin No. 10]
- No. 4 Some Selected References: Pros and Cons of Using the Hand-Held Calculator. April 1977. [2 pages, non-annotated; superseded by Reference Bulletin No. 11]

- No. 5 College-Level References on Calculators. April 1977.
[4 pages, annotated; superceded by Reference Bulletin No. 13]
- No. 6 Selecting a Calculator. May 1977. [5 pages, annotated;
superceded by Reference Bulletin No. 12]
- No. 7 Instruction with Hand-Held Calculators, K-12. August 1977.
8 pages, annotated]
- No. 8 Books on Calculator Applications. August 1977. [4 pages,
non-annotated]
- No. 9 Research on Hand-Held Calculators, K-12. August 1977.
[11 pages, annotated, preceded by introductory summary]
- No. 10 Information on Desk Calculators, K-12. August 1977.
[6 pages, annotated]
- No. 11 Pros and Cons of Using Hand-Held Calculators. August 1977.
[4 pages, non-annotated, preceded by introductory summary]
- No. 12 Selecting a Calculator. August 1977. [5 pages, annotated]
- No. 13 References on Calculators, Post-Secondary Level. August
1977. [6 pages, annotated]
- No. 14 Instruction with Hand-Held Calculators, K-12. December 1977.
[4 pages, annotated]
- No. 15 Instruction with Hand-Held Calculators, K-12. June 1978.
[8 pages, annotated]
- No. 16 Books on Calculator Applications. June 1978. [1 page,
annotated]
- No. 17 Research on Calculator Uses, K-12. June 1978. [3 pages,
annotated]
- No. 18 References on Calculators, Post-Secondary Level. June 1978.
[2 pages, annotated]
- No. 19 Instruction with Hand-Held Calculators, K-12. December 1978.
[6 pages, annotated]
- No. 20 Books on Calculator Applications. December 1978. [1 page,
non-annotated]
- No. 21 Research on Calculator Uses, K-12. December 1978. [3 pages,
annotated]
- No. 22 References on Calculators, Post-Secondary Level. December
1978. [4 pages, annotated]

- No. 23 References on Instructional Activities, Research Reports, and Other Topics Related to Calculator Use, K-12. April 1979. [6 pages, annotated]
- No. 24 References on Instructional Use and Research with Calculators at the College and Other Post-Secondary Levels. April 1979. [2 pages, annotated]

(2) Information Bulletins

- No. 1 Types of Calculators (prepared by Jon L. Higgins, The Ohio State University). January 1978. [3 pages]
- No. 2 Calculator Activities for Secondary Grades (prepared by Dwayne Channell, The Ohio State University). December 1977. [2 pages]
- No. 3 Suggestions for Calculator Selection (prepared by Marilyn N. Suydam). June 1978. [3 pages]
- No. 4 Calculators and Instruction: An Information Bulletin for Administrators (prepared by Mary Harley Jones and R. C. Bosley, Fairfield County, Virginia, Public Schools). December 1978. [4 pages]
- No. 5 Leading a Calculator Workshop (prepared by Jane Donnelly Gawronski, San Diego County Department of Education). December 1978. [4 pages]
- No. 6 Calculators in Grades K-3: Why? What? How? (prepared by Theresa Denman, Detroit Public Schools). January 1979. [6 pages]
- No. 7 How to Get Started Using Calculators in Your Classroom, Grades 4-6 (prepared by George Immerzeel and Earl Ockenga, University of Northern Iowa). May 1979. [6 pages]

(3) State-of-the-Art Reviews

Two state-of-the-art reviews have been prepared (by Marilyn N. Suydam); each is a short, non-technical summary on the use of calculators in mathematics education, including discussion of relevant research and of instructional practices and reactions. The titles are:

- (1) State-of-the Art Review on Calculators: Their Use in Education. April 1978. [12 pages]
- (2) The Use of Calculators in Pre-College Education: A State-of-the-Art Review. May 1979. [8 pages]

(4) Summary Documents

- (a) Investigations with Calculators: Abstracts and Critical Reviews of Research (edited by Marilyn N. Suydam). January 1979. ERIC: SE 027 581.
- (b) Investigations with Calculators: Abstracts and Critical Reviews of Research - Supplement (edited by Marilyn N. Suydam). June 1979. ERIC: SE 027 820.
- (c) Reference Bulletins from the Calculator Information Center (compiled by Marilyn N. Suydam). ERIC: SE 026 880.
- (d) Information Bulletins from the Calculator Information Center (compiled by Marilyn N. Suydam). ERIC: SE 027 798.
- (e) State-of-the-Art Reviews (Marilyn N. Suydam). ERIC: SE 027 797.

Calculators: A Categorized Compilation of References

Addis, G. H. The Use of Programmable Calculators in the Teaching of Economics, Part II. Economics 14: 50-58; Summer 1978.

The use of programmable calculators to perform classroom controlled experiments on economic models is described.

[College, Economics, Programmable calculators]

Adkins, Steve S. Easy Fractional Conversion from/to Base 10 to/from Any Lower Base. Calculators/Computers 1: 63-66; October 1977.

Shortcuts for converting base ten integers to or from other lower base integers are discussed in terms of the key strokes used on a four-function calculator. A student worksheet with accompanying answer sheet is included.

[Four-function calculators, Nondecimal bases, Worksheets]

Advani, Kan. The Effect of the Use of Desk Calculators on Achievement and Attitude of Children with Learning and Behaviour Problems. A Research Report. December 1972. ERIC: ED 077 160.

Eighteen students (ages 12 to 15) used four calculators for six months to check mathematics problems. Comparisons of pre- and posttest data indicated significant increases in student interest and positive attitudes toward mathematics, while disruptive behaviors decreased.

[Achievement, Attitudes, Checking, Desk calculators, Learning disabilities, Research, Secondary]

Ahl, David H. (editor). The Best of Creative Computing, Volume 1, Volume 2. Morristown, New Jersey: Creative Computing Press, 1978.

Some games to be played with calculators are included.

[Activities, Games]

Aidala, Gregory. Calculators: Their Use in the Classroom. School Science and Mathematics 78: 307-311; April 1978.

The use of 15 calculators to promote problem-solving skills in an eighth-grade class is described. Suggestions and recommendations are included.

[Junior high (grade 8), Problem solving, Recommendations]

Aidala, Gregory and Rosenfeld, Peter. Calculators in the Classroom. Mathematics Teacher 71: 434-435; May 1978.

The use of 15 calculators in an eighth-grade class is described, with an exercise on volume cited.

[Junior high (grade 8), Measurement, Problem solving]

Albrecht, Bob. Calculators for Beginners. Calculators/Computers 1: 21-26; May 1977. 1: 75-82; October 1977. 1: - ; December 1977. 2: 61-66; January 1978. 2: 91-96; March 1978. 2: 23-28; April 1978. 2: 87-95; May 1978.

This set of articles is a serialization of a self-teaching student workbook about four-function calculators and elementary computer programming. The articles cover: (1) Basic addition, subtraction, and multiplication; some computer-like notation for writing programs to solve problems; and directions for playing NIM. (2) Multiplication, powers, and multiplication game. (3) Division. (4) Mixed operations. (5) The change sign key. (6) A calculator version of the game Krypto. (7) The concept of memory and keys for manipulating numbers in memory.

[Calculator keys, Calculator memory, Four-function calculators, Games, Mixed operations, Powers, Problem solving, Programming, Worksheets]

Albrecht, Robert L. and others. The Role of Electronic Computers and Calculators in Mathematics Instruction. In Instructional Aids in Mathematics (edited by Emil J. Berger). Thirty-fourth NCTM Yearbook. Washington: National Council of Teachers of Mathematics, 1973. Pp. 181-187.

Various types of computing devices are described, and their usefulness in the classroom discussed. Scant attention is devoted to calculators in general, and none to the hand-held calculator as a distinct instructional aid. The authors state that electronic calculators are "far more powerful problem-solving tools than conventional machines."

[Desk calculators]

Aldridge, Wanda Scott. Effects of Electronic Calculators on Achievement of Middle School Remedial Mathematics Students. (University of Georgia, 1976.) Dissertation Abstracts International 37A: 4078; January 1977.

Eighty-three middle school remedial math students used calculators as they worked through lessons in the Computational Skills Development Kit on an individualized basis for 4 weeks, while 90 students did all the required calculation with paper and pencil. Results on a standardized arithmetic skills posttest showed that the non-calculator groups scored significantly higher ($p < .001$) than the calculator group. Eighth graders in the calculator group scored higher than eighth graders in the non-calculator group, however.

[Achievement, Desk calculators, Elementary (grade 6), Junior high (grades 7-8), Remedial, Research]

Allen, Maxine Bogues. Effectiveness of Using Hand-Held Calculators for Learning Decimal Quantities and the Metric System. (Virginia Polytechnic Institute and State University, 1976.) Dissertation Abstracts International 37A: 850-851; August 1976.

During a 25-day unit on decimal algorithms and on the metric system, four intact sixth-grade classes used calculators for all computations while two classes used only paper and pencil. No significant

differences between the two groups were found on the posttest, but on the retention test the group using only paper and pencil scored significantly higher on both the decimal and the metric tests than the calculator group.

[Achievement, Decimals, Elementary (grade 6), Measurement, Research]

Anderson, Lyle Eugene. The Effects of Using Restricted and Unrestricted Modes of Presentation with Electronic Calculators on the Achievement and Attitude of Seventh Grade Pupils. (University of Denver, 1976.) Dissertation Abstracts International 37A: 6321-6322; April 1977.

Three seventh-grade mathematics classes taught by the same teacher were randomly selected at each of four schools for the 20-week study. One class in each school was permitted restricted use of calculators (for checking paper-and-pencil computation and as an aid in problem solving), a second class was permitted unrestricted calculator use, and a third class was not permitted to use calculators. Pupils using calculators showed improved attitudes toward mathematics but no change in achievement, understanding of mathematical concepts, or computational skill. On an untimed problem-solving test, pupils using calculators solved problems correctly at almost twice the rate of pupils not using calculators.

[Achievement, Attitudes, Junior high (grade 7), Research]

Andrews, Frances K. Self-Instructional Course in Business Machines. Teacher Edition and Student Edition. ERIC: ED 105 203. 1972.

[Business education, Course description, Desk calculators]

Angus, Ian. The Gamma Function. New Zealand Mathematics Magazine 15: 60-64; September 1978.

Activities

Arens, E.; Meissner, H.; and Vogt, Ch. Taschenrechner in der Grundschule. Der Mathematikunterricht 24: no. 1, 1978.

[Roles]

Aronofsky, Julius; Frame, Robert J.; and Greynolds, Elbert B., Jr. Programmable Calculators: Business Applications. New York: McGraw-Hill, 197 .

This book stresses basic computational skills and elementary and advanced programming techniques. It is correlated with TI programmable calculators.

[Business education, Post-secondary, Programmable calculators]

Asmus, Paul. Calculators vs. Minis. Datamation 18: 55-58; April 1972.

A summary of key features to compare when deciding on either a programmable calculator or a minicomputer are listed. Consideration is given to the kinds of work to be done, flexibility needed, experience of users, operating features, and price.

[Desk calculators, Selection]

Austin, Keith. Play Your Pocket Calculator at Master Mind. Mathematics Teaching 86: 13; March 1979.

An activity involving place value is briefly described.

[Games, Place value]

Averett, Dorothy M., et al. Using the Mini-Calculator to Teach Mathematics. Philadelphia: Curriculum Office, Instructional Services, School District of Philadelphia, 1977.

Calculator activities are presented for the following topics: place value, rounding off numbers and estimating answers, whole numbers, decimal fractions, common fractions, number patterns, powers and roots, algebra, geometry, and advanced topics. Other sections cover selecting a calculator for classroom use, preparing to use the calculator, types of use, the keyboard, "word-number" displays and problems, and additional source materials.

[Activities, Elementary, Secondary]

Aviv, Cherie Adler. Pattern Gazing. Mathematics Teacher 72: 39-43; January 1979.

Worksheets on pattern searches are provided.

[Integers, Pattern searches, Secondary (grades 7-12)]

Ayers, Sharon Whitton. The Effects of Situational Problem Solving and Electronic Calculating Instruments in a College Level Introductory Statistics Course. (Georgia State University - School of Education, 1976.) Dissertation Abstracts International 37A: 6322-6323; April 1977.

See also: Research Reporting Sections, NCTM 57th Annual Meeting. Columbus, Ohio: ERIC/SMEAC, March 1979. Pp. 57-58.

For an eight-week period, each of four intact introductory statistics classes (n = 172) was randomly assigned to one of four treatment conditions corresponding to two instructional modes (emphases on situational problem solving vs. no such emphasis) and two computational methods (access to electronic calculating instruments vs. no such access). Significant main effects of computational achievement on statistics content and of instructional mode on both attitude toward mathematics and view of statistics were found.

[Achievement, Attitudes, College, Research, Statistics]

Babani, M. H. Electronic Calculator Users Handbook. England: Babani Press, 1978.

[Activities, College]

Bahe, L. W. Finding Logarithms and Antilogarithms with a Simple Calculator. School Science and Mathematics 74: 221-224; March 1974.

A method of finding logarithmic values using a simple matrix and a four-function calculator is provided.

[Four-function calculators, Logarithms, Secondary]

Bakke, Laurie. Calculator: Logic System Comparison (Arithmetic vs RPN vs Algebraic). North Dakota Council of Teachers of Mathematics Journal 1: 39-40; 1978.

[Calculator logic]

Ball, John A. Algorithms for RPN Calculators. New York: John Wiley & Sons, 1977.

[Algorithms, College, Programmable calculators, Scientific calculators]

Ballotto, S. Calculators--Powerful and Portable. Administrative Management 33: 66-80; February 1972.

(See also: Ballotto, S. Calculators--They Just Keep Multiplying. Administrative Management 33: 68; August 1972.

Descriptions of calculator models introduced up to early 1972 are provided.

[Selection]

Barnard, Janet. Calculators in Elementary School. Math Lab Matrix 5: 4; Spring 1976. (Illinois State University)

Classroom management procedures for using a calculator in an elementary school class are described.

[Classroom management, Elementary, Four-function calculators]

Barrett, Ray and Keefe, Michael. Using Hand-Held Calculators in Sixth Grade Classes. Albany, New York: The State Education Department, Bureau of Mathematics Education, 1974. ERIC: ED 142 410.

Each student in the authors' classes was assigned a calculator for use throughout the year. The calculators permitted exploration of a variety of topics; word problems, arithmetic means, probability, palindromes, functions, and decimal multiplication were particularly successful. Student interest was sustained throughout the year.

[Elementary (grade 6), Four-function calculators]

Bartusiak, Marcia F. Calculatoritis. Science News 114: 347; November 18, 1978.

The fear of over-reliance on the habit-forming calculator is discussed.

[Pros/cons]

Bawtree, Michael. Numerical Solutions without Calculus. Mathematics in School 8: 19-20; March 1979.

Programming a calculator for "cubic" equations is described.

[Algebra, Programmable calculators, Programming]

Beakly, George C. and Leach, H. W. The Slide Rule, Electronic Hand Calculator, and Metrification in Problem Solving (Third Edition). New York: Macmillan, 1975.

A comparison of reverse-Polish and algebraic logic is given, in addition to descriptions of the three major types of hand-held calculators currently on the market.

[Calculator logic, Selection]

Beardslee, Edward C. Calculators: Curse or Cure? Washington Mathematics, January 1977.

Twenty-three student teachers took an attitude survey before and after participating in a calculator workshop. Where prior to the workshop only 2 students were agreeable to the possibility of using the calculator in all phases of the K-6 mathematics program, after the workshop 17 students were agreeable. Before the workshop 8 students felt calculators should not be used at all, while afterward, no one said that.

[Attitudes, Research, Teachers (preservice)]

Beardslee, Edward C. Teaching Computational Skills with a Calculator. In Developing Computational Skills (Marilyn N. Suydam, editor). 1978 NCTM Yearbook. Reston, Virginia: National Council of Teachers of Mathematics, 1978.

Ways to use a calculator as an integral part of mathematics instruction in existing curricula are provided. Activities are proposed that will help children think about mathematics rather than merely push buttons.

[Activities, Elementary, Four-function calculators, Games]

Beare, Richard. Programmable Calculators. Part I: Their Use in Teaching Science. School Science Review 59: 36-48; September 1977. Part II: Their Use in Applying Simple Laws in Physics to Some Complex Problems. 59: 269-284; December 1977.

Examples from advanced secondary school science which are amendable to the use of a programmable calculator are given. The use of calculators and computer terminals is compared. In the second article, applications in physics are provided.

[Physics, Problem solving, Programmable calculators, Roles, Science, Secondary]

Beare, Richard and New, Peter J. Programmable Calculators for Elementary Physics Teaching. Physics Education 12: 424-426; November 1977.

Operating characteristics and features of programmable calculators are compared.

[Physics, Programmable calculators, Selection]

Beck, Lois L. A Report on the Use of Calculators. Arithmetic Teacher 7: 103: February 1960.

Fourth-, fifth-, and sixth-grade classes used Monroe Educator calculators; these calculators performed the basic operations in much the

same way they are done with paper and pencil. Although complete results were unavailable at the time of writing, several observations were made. The calculators could be operated by the students; when used as a regular classroom tool, they tended to motivate and reinforce understanding and achievement in basic skills. Children seemed to enjoy using the calculators, and to exhibit better work habits. Place-value concepts were reinforced.

[Desk calculators, Elementary (grades 4-6), Research]

Beisse, Karen; Brougher, Janet; and Moursund, David. Calculators in the Elementary School. Portland, Oregon: Oregon Council for Computer Education, May 1976.

The role of the calculator in the elementary-school classroom is briefly discussed. Suggestions for calculator activities are given, with informal evaluations of the activities.

[Activities, Elementary, Four-function calculators]

Bell, A.; Burkhardt, H.; McIntosh, A.; and Moore, G. A Calculator Experiment in a Primary School. Shell Centre for Mathematical Education, University of Nottingham, 1978.

How calculators were used by teachers in the experimental school to improve the teaching of certain mathematical topics is described and assessed, with examples of teaching materials and children's responses.

[Activities, Elementary, Research]

Bell, Frederick H. Can Computers Really Improve School Mathematics? Mathematics Teacher 71: 428-433; May 1978.

This discussion on the role of computers in mathematics classes points out that "many of the teaching and learning activities that were enhanced by computers in schools during the 1970s can now be carried out with relatively inexpensive calculators."

[Roles]

Bell, Max S. What Does "Everyman" Really Need from School Mathematics? Mathematics Teacher 67: 196-202; March 1974.

The calculator is cited as one reason why expectations of mathematical competencies should change.

[Recommendations]

Bell, Max S. Calculators in Elementary Schools? Some Tentative Guidelines and Questions Based on Classroom Experience. Arithmetic Teacher 23: 502-509; November 1976.

Student reactions to calculators, some pedagogical questions that may need further investigation, and some classroom management suggestions are discussed.

[Attitudes, Classroom management, Elementary, Pros/cons, Recommendations]

Bell, Max. Needed R&D on Hand-Held Calculators. Educational Researcher 6: 7-13; May 1977.

This article reports on the conference on needed research and development on calculators which was conducted in June 1976 by NIE and NSF. General background and working assumptions, the present state of mathematics education as a context for conference recommendations, some failed dichotomies, priorities for curriculum development, tentative guidelines for research and curriculum development, and recommendations are covered.

[Recommendations, Research (needed), Roles]

Bell, Max. Calculators in Secondary School Mathematics. Mathematics Teacher 71: 405-410; May 1978.

The effects of calculators on education, including discussion of potential strengths and weaknesses, are described. Specific suggestions for needed curriculum development are presented.

[Pros/cons, Roles]

Bell, Max; Esty, Edward; Payne, Joseph N.; and Suydam, Marilyn N. Hand-held Calculators: Past, Present, and Future. In Organizing for Mathematics Instruction (F. Joe Crosswhite, editor). 1977 NCTM Yearbook. Reston, Virginia: National Council of Teachers of Mathematics, 1977.

An overview is provided for each of four reports dealing in whole or in part with calculators (the NACOME Report, the Euclid Conference Report, the status report to the NSF on calculators in pre-college education, and the report on the Conference on Needed Research and Development on Hand-held Calculators in School Mathematics). Activities in several school systems are also cited.

[Curriculum, Elementary, Pros/cons, Research (needed), Secondary, Status report]

Benrey, Ronald. How to Get the Most Out of Your Low-Cost Electronic Calculator. Rochelle Park, New Jersey: Hayden Book Co., 1976.

[Activities]

Berg, Gary. Teaching Flow-charting Through Electronic Calculators. Business Education Forum 24: 30; January 1970.

Flow-charting symbols and a flow-chart describing a use of the calculator are presented, in relation to the use of calculators in businesses.

[Business education, Desk calculators, Flow charts]

Berger, I. Electronic Calculators: How to Choose the Right One. Popular Mechanics 139: 86-90; February 1973.

Features to look for, how much to spend, and consideration of one's particular needs are discussed. Both desk and hand-held calculators are considered.

[Selection]

Berger, I. Calculators Get Smaller, Smarter, and Cheaper. Popular Mechanics 142: 70-75; December 1974.

Features to look for and what models have those features are indicated in this guide to buying a hand-held calculator.

[Selection]

Berger, Ivan. Super Math from Simple Kits. Popular Mechanics 143: 104; May 1975.

Features of four electronic calculators that can be built from kits are described.

[Building, Selection]

Berkowitz, S. A Rational Number Calculator. Datamation 16: 106; 1973.

A description is given of how a calculator might be built to save and display a quotient of two rational numbers regardless of length.

[Building, Rational numbers]

Betts, Emmett A. A Preliminary Investigation of the Value of a Calculating Machine for Arithmetic Instruction. Education 58: 229-235; December 1937.

The effect of practice with a calculating machine on the pupil's problem-solving techniques and computational skills was studied. Thirteen pupils in the second half of sixth grade completed the year's work in the six-week treatment period. Gain scores from four tests were compared, with improvement found in each case. Pupils were able to analyze more problems in the time available than they usually did.

[Achievement, Desk calculators, Elementary (grade 6), Problem solving, Research]

Billings, Karen and Moursund, David. Problem Solving with Calculators. Salem, Oregon: The Math Learning Center, University of Oregon, 1978.

[Curriculum, Problem solving, Worksheets]

Billings, Karen and Moursund, David. Problem Solving Using Calculators. Calculators/Computers 2: 17-32; September/October 1978.

This is the first part in a serialized version of a book. It presents prefaces for teachers and for students, workpages for getting started, and worksheets on calculator letters, symmetries, order of operations, exponents, powers, and chaining.

[Problem solving, Worksheets]

Billings, Karen and Moursund, David. Problem Solving. Calculators/Computers 2: 73-94; November-December 1978.

Chapter 2 of Problem Solving with Calculators is given. How to tackle a variety of problems is explained, using a worksheet-like format.

[Problem solving, Worksheets]

Billings, Karen and Moursund, David. Calculator Memory. (Chapter 6 from Problem Solving with Calculators.) Oregon Computing Teacher 6: 11-29; December 1978.

This chapter from the authors' book explores use of the calculator memory for various applications, using a worksheet-like format.

[Calculator memory, Problem solving, Worksheets]

Billstein, Rick and Lott, Johnny W. When Does a Fraction Yield a Terminating Decimal? Calculators/Computers 2: 15-19; January 1978.

A two-hour module used in a Calculator Usage in Elementary Schools class for teachers is presented; it is appropriate for use in grades 7 and 8. Using worksheets, students convert fractions to decimals using any four-function calculator, do the prime factorization of the denominator, and find patterns formed by the denominator of the fractions that are terminating decimals.

[Junior high (grades 7-8), Rational numbers, Teachers (preservice), Units, Worksheets]

Birtwhistle, Claude. Some Further Comments on Electronic Calculators. Mathematics Teaching 66: 27-30; March 1974.

The author comments that pocket calculators are too easily lost, and their keys and displays are too small; small portable desk calculators are recommended instead. Several models are available for performing the four basic operations; the order in which keys are punched to perform calculations varies with the different machines, and the unnaturalness of some orders can cause problems for some children. For low achievers, electronic calculators are probably not as effective as the old type. For average and above-average students, however, the calculator presents advantages in speed and accuracy. By taking the tedium out of complex computations, it can encourage thought about the answer. Calculator use allows complex topics to be introduced at lower levels in the curriculum.

[Pros/cons, Selection]

Birtwhistle, Claude. The Electronic Calculator. England: Elliot Right Way Books, 1977.

[Consumer applications, Four-function calculators]

Birtwhistle, Claude. The Calculator Puzzle Book. England: Elliot Right Way Books, 1978.

[Activities]

Bitter, Gary. The Calculator and the Curriculum. Teacher 94: 64-67; February 1977.

Using the calculator for interdisciplinary projects is discussed, with a list of 15 topics and activities in which calculators can be used. Six interdisciplinary activities are described in detail: for primary grades--car counting, planning and planting a garden;

for intermediate grades--population growth, organizing a recycling program; for upper grades--school election prediction and polls, pollution analysis.

[Activities, Elementary, Roles]

Bitter, Gary G. Calculator Power, Books 1-6. St. Paul, Minnesota: EMC Corporation, 1977.

[Elementary, Four-function calculators, Mixed operations, Worksheets]

Bitter, Gary G. Curriculum Considerations for Use of the Hand-Held Calculator. Calculators/Computers 2: 15-16; September/October 1978.

Different logic systems, rounding, converting fractions to decimals, decimal representation of a fraction, overflow, underflow, truncation, order of operations, "add-on" percent key, constant key, internal counting, division by zero, the negative sign, and consecutive operations are considered.

[Selection]

Bitter, Gary G. and Metos, Thomas H. Exploring with Pocket Calculators. New York: Julian Messner, Inc., 1977.

[Elementary, Roles]

Bitter, Gary G. and Nelson, Dennis. Arizona Migrant Education Hand-Held Calculator Project. Migrant Educator 1: 1-3; 1975.

Evidence is presented that hand-held calculators can be used successfully in remedial mathematics programs.

[Elementary (grades 4-6), Junior high (grade 7), Remedial, Research]

Bitter, Gary G.; Engelhardt, Jon M.; and Wiebe, James. One Step at a Time. St. Paul, Minnesota: EMC Corporation, 1977.

This text, developed to help teachers learn a diagnostic/prescriptive approach, includes cross-references to pages in Calculator Power (Bitter, 1977).

[Diagnosis, Teachers]

Blakeley, B. H. Some Calculator Questions. Mathematics in School 7: 18; March 1978.

Questions prepared for consideration at the SMP Computing in Mathematics Group are presented.

[Roles]

Blakeley, Barry. Palindromes. Mathematics in School 8: 29; March 1979.

A game is briefly presented.

[Games]

Blodgett, James. The Minimum Computer. Creative Computing 2: 22-23; November-December 1976.

The question "At what level of complexity does a programmable calculator become a computer?" is discussed. Features of the Hewlett-Packard HP-25 programmable calculator are described.

[Programmable calculators, Selection]

Blume, Glendon W. and Mitchell, Charles E. The Calculator's Effect on Children's Solution Processes. Paper presented at NCTM 57th Annual Meeting, April 1979. ERIC: SE 027 673.

Three preliminary studies and one exploratory main study investigated the effect of calculator use on students at a variety of grade levels. For the 83 eighth-grade students in the main study, there was a significant association between calculator use and choice of the longer solution method on 5 of 7 items. The heuristics of simplification and application of a structure property such as distributivity appear to be calculator-inhibited rather than calculator-enhanced in the absence of specific instruction designed to encourage their use in conjunction with calculator computations. The number of errors in conceptualization of the problem does not appear to be affected by calculator use.

[Elementary, Research, Secondary, Solution methods]

Bolduc, E. J. Using a Minicalculator to Find an Approximate Value for π . School Science and Mathematics 77: 689-691; December 1977.

Geometry and a hand-held calculator are used to find a value of π accurate to five decimal places.

[Geometry]

Bolesky, Edward Michael. The Influence of Electronic Hand-Held Calculators on Cognitive Achievement in Chemistry. (Boston College, 1977.) Dissertation Abstracts International 38A: 1319-1320; September 1977.

Eighty college-preparatory CHEM Study chemistry students were randomly assigned to either a calculator group or a non-calculator group for a one-semester study. The calculator group used calculators during class sessions to perform calculations for homework, laboratory exercises, and chapter tests and quizzes. No significant differences in chemistry achievement were found between the two groups on the posttest measures.

[Achievement, Chemistry, Research, Secondary]

Boling, Mary Ann Neaves. Some Cognitive and Affective Aspects of the Use of Hand-Held Calculators in High School Consumer Mathematics Classes. (The Louisiana State University and Agricultural and Mechanical College, 1977.) Dissertation Abstracts International 38A: 2623-2624; November 1977.

Over a period of 19 weeks, a group of 51 twelfth-grade consumer mathematics students used calculators to perform all computations,

while a group of 43 students used traditional paper-and-pencil methods. No significant differences in mathematical problem-solving achievement or in attitude toward mathematics were found between the two groups. Strong positive attitudes toward the use of calculators in the classroom were found.

[Achievement, Attitudes, Consumer mathematics, Research, Secondary (grade 12)]

Borden, Virginia Lee. Teaching Decimal Concepts to Sixth Grade Students Using the Hand-Held Calculator. (University of Northern Colorado, 1976.) Dissertation Abstracts International 37A: 4192; January 1977.

A unit on decimals constructed to precede a study of common fractions was taught to four classes of sixth graders, with two of the classes using calculators while the other two classes did not. Both groups showed a significant gain in mathematics achievement of certain concepts and skills in decimals. It was not reported if any differences in achievement or attitudes were found when the calculator group was compared to the non-calculator group. The non-calculator group showed a significant negative change in attitude toward mathematics.

[Achievement, Attitudes, Decimals, Elementary (grade 6), Research, Units]

Bormann, Thomas M. Electronic Calculating: Processing of Thoughts. Journal of Business Education 48: 302-303; April 1973.

Advantageous characteristics of calculators for office use are cited. Business education objectives are discussed in relation to guidelines for calculator instruction.

[Business education, Recommendations, Selection]

Bosley, R. C. Calculator Research Here and There. Virginia Council of Teachers of Mathematics 5: 3-4; October 1978.

[Research (review)]

Bourjaily, Bill and Radachy, Marc. Mathematics by Calculator. Berea, Ohio: Berea City School District, 1977.

This year-long course for Mathematics 9-10 is designed to assist students who have had difficulty in mathematics as well as those who are unmotivated. Computational skills are applied in practical situations. Number, operation, space, symbolism, relation, proof, and approximation concepts are included as well as skills in computation with whole numbers, fractions, and decimals.

[Course description, Mixed operations, Remedial, Secondary (grades 9-10)]

Boyle, Patrick J. Calculator Charades. Mathematics Teacher 69: 281-282; April 1976.

Computations yielding results which can be read as words or phrases are presented.

[Activities, Four-function calculators, Secondary]

Bradshaw, M. Eugene. Programmable Calculator as a Test Controller. Machine Design 50: 64-65; April 20, 1978.

College, Programmable calculators

Brasel, Karen. Calculator Craze. The Official ICTM Journal 6: 3-15; Fall 1977.

[Roles]

Braun, Alexander E. Eulogy for a Slide Rule. Science Digest 79: 65-67; February 1976.

The "passing" of slide rules is humorously decried.

[Slide rule]

Bravin, B. How to Extract Roots and Compute Noninteger Powers with Your Own Inexpensive Electronic Calculator. Design News 28: 61; 1973.

[Powers, Roots]

Briggs, A. G. The Rydberg Constant--A Hand-Calculator Exercise. Physics Teacher 16: 291-292; May 1978.

Described is a hand-held calculator exercise for computing the Rydberg Constant accurately.

[College, Physics]

Bright, George. Ideas. Arithmetic Teacher 25: 28-32; February 1978.

Calculators may be used in solving pattern-recognition problems.

[Elementary, Pattern searches, Worksheets]

Bristol, James D. The Hand-Held Calculator: To Grind Out Answers or To Teach Mathematics? Ohio Journal of School Mathematics 1: 21-28; February 1978.

(See also: West Virginia Council of Teachers of Mathematics Newsletter 3: 19-27; 1978.

[Roles]

Broussard, Vernon; Fields, Albert; and Reusswig, James. A Comprehensive Mathematics Program. AV Instruction 14: 43-44, 46; February 1969.

A program for low achievers in grades 7-9 from disadvantaged areas which emphasized real-world applications and use of flow charts, calculators, and other materials, resulted in significant achievement gain. Sixty percent of the students who had participated in the program continued to take mathematics courses, compared with 40 percent in a control group.

[Achievement, Desk calculators, Junior high (grades 7-9), Low achievers, Research]

Brown, Ken. Individualized Calculators. VCTM Newsletter 9: 2; March 1978.

[Roles]

Brown, Lynn. Calculators in Secondary School. Math Lab Matrix 5: 4, 11; Spring 1976. (Illinois State University)

Seven activities with the calculator, appropriate for junior and senior high school students, are suggested.

[Activities, Junior high, Secondary]

Bruni, James V. and Silverman, Helene J. Let's Do It! Taking Advantage of the Hand Calculator. Arithmetic Teacher 23: 494-501; November 1976.

Activities are suggested which focus on developing skills for using the calculator, exploring basic arithmetic operations, understanding algorithms, mental calculation and estimation, and problem solving.

[Activities, Elementary, Estimation, Mixed operations, Problem solving]

Buchman, Aaron L. The Use of Calculators and Computers in Mathematics Instruction in New York State High Schools. School Science and Mathematics 69: 385-392; May 1969.

Only 13 percent of the schools reported (in 1967-68) having calculators in the mathematics department, with 2 percent of these having computer features. Five percent of the schools had computer facilities which were used by mathematics classes.

[Desk calculators, Research (survey), Secondary]

Buck, R. C. and Buck, Ellen F. Introduction to Differential Equations. Boston: Houghton-Mifflin, 1976.

This upper-class text contains much technical material which can be explored by students on a calculator. An appendix contains a simple program for use with a programmable calculator.

[College, Differential equations, Programmable calculators]

Buckwalter, L. Now It's Pocket Calculators. Mechanics Illustrated 69: 108-109; February 1973.

The role of calculators is explored, with comments on their potential uses.

[Roles]

Buckwalter, Len. How to Make Use of a Mini Calculator. Mechanix Illustrated 71: 40, 98; February 1975.

Advantages of using a calculator for solving a variety of practical problems (such as car gasoline consumption, home energy consumption, and tiling a floor) are discussed.

[Consumer applications, Pros/cons]

Buckwalter, Len. 100 Ways to Use Your Pocket Calculator. Greenwich, Connecticut: Fawcett Publications, Inc., 1975.

The first three chapters discuss the impact of the calculator on your society, how to shop for the calculator most suitable for you, and how to operate a calculator with touch control. The chapters that follow give formulas and examples for calculating everything from electricity to stocks to automobile depreciation. At the end are a few puzzles and tricks to do on the calculator.

[Consumer applications, Roles, Selection]

Bukowski, Joseph E. A Survey of Attitudes on the Use of Calculators in the College Classroom. (Ed.D. Practicum, Nova University.) June 1975. ERIC: ED 129 613. 20 pages.

This study focused on faculty and student attitudes toward the use of calculators in college accounting and business mathematics courses. Two different surveys were used; one was administered to 35 full-time and part-time faculty in the accounting and business mathematics areas at one college, while a second survey was administered to a random sample of 244 students. Responses from both the faculty and students indicated fairly consistent attitudes. A seemingly larger portion of students felt that calculators should be allowed unconditionally, while the faculty appeared to have some reservations on the use of calculators, especially in classes of business mathematics.

[Attitudes, Business mathematics, College, Research (survey)]

Burger, Vernon K. Design, Production, Evaluation, and Revision of a Self-Instructional Package for the HP-45 Electronic Slide Rule. (Ed.D. Practicum, Nova University.) August 1974. ERIC: ED 104 721.

The author designed an instructional package including slides and tape cassettes for individual use by students learning to use a hand calculator to perform computations. Students (n = 17) using the package were given pretests and posttests of ability and attitude. On the three sets of cognitive objectives, mastery was achieved by 96 percent, 76 percent, and 76 percent of the students, respectively. All students reported favorable attitudes to the unit. The author discusses planned revisions of the program, and relationships among the variables.

[Achievement, College, Course description, Research]

Butler, R. H. Calculators in the Classroom--A Dilemma. New Zealand Mathematics Magazine 15: 46-48; September 1978.

[Roles, Pros/cons]

Bryant, Carl. All About Typewriters and Adding Machines. Hawthorn, 1973.

[Business education]

Budlong, Thomas S. What to Look for in a Microcalculator. Machine Design 44: 155-161; November 14, 1972.

A checklist of features to consider when choosing a hand-held scientific calculator are listed. Features are described, with a summary of the characteristics of 17 engineering calculators.

[Engineering, Scientific calculators, Selection]

Campbell, Patricia and Virgin, A. E. An Evaluation of Elementary School Mathematics Programs Utilizing the Mini-Calculator. North York Board of Education, Ontario, Canada, July 1976. ERIC: ED 137 120.

For a seven-month period, fifth and sixth graders in one school had calculators available in their classrooms for checking their work, while at a second school no calculators were permitted. A standardized mathematics achievement test and an attitude questionnaire were given as pre- and posttests. On the computation subtest there were no significant differences in the gain scores between the two schools. On both the mathematics concepts and the problem solving subtests, fifth graders in the calculator group scored significantly higher than fifth graders in the non-calculator group.

[Achievement, Attitudes, Elementary (grades 5-6), Research]

Campbell, Patricia and Virgin, Albert. A Survey of Elementary School Teachers' and Principals' Attitudes to Mathematics and Utilizing Mini-Calculators. North York Board of Education, Ontario, Canada, July 1976. ERIC: ED 137 021.

Investigator-constructed questionnaires were distributed to fourth-, fifth-, and sixth-grade teachers and to elementary school principals to determine their attitudes toward the use of calculators in the classroom. Results showed that just over half of the 183 teachers responding did not think that the use of a calculator would help them realize their teaching objectives for mathematics. Almost half of the teachers felt that the calculator could be introduced between grades 4 and 6, while 44 percent indicated a preference for after grade 6. Teachers and principals were not unlike in their attitudes toward the use of the calculator in the classroom and were consistent in identifying similar advantages and disadvantages of using calculators.

[Attitudes, Elementary, Principals, Research (survey), Teachers grades 4-6]

Cantor, Charles B. Now That the Electronic Calculator Fits in Your Pocket, How Will It Fit in Your Math Class? Business Education World 5: 29; November/December 1974.

Future uses of the calculator in business classrooms are discussed, with comments on such topics as programming, artificial intelligence, and electronic classrooms.

[Business education, Roles]

Capoferi, Alfred. Local District Field Studies Support the Use of Hand Calculators in the Classroom. Mathematics in Michigan 16: 3-13; May 1977.

Field studies on the use of calculators in grades 4, 5, and 6 are described. Calculator specifications, how to use the calculator, and when to use the calculator are outlined, with observations from experiences during the field studies and recommendations listed.

[Elementary (grades 4-6), Research (field study), Selection]

Capoferi, Alfred and Winowski, Eugene. Macomb Intermediate School District, Van Dyke Schools Cooperative Project - Exploration of Classroom Use of the Hand Calculator in Grades 4-6. Mt. Clemens, Michigan: Macomb Intermediate School District, 1975.

The project is briefly described, and many examples of mathematics topics appropriate for the calculator are provided.

[Activities, Elementary (grades 4-6), Research (field study)]

Capoferi, Alfred; Winowski, Eugene; and Schram, James. Macomb Intermediate School District, Fitzgerald and Van Dyke Public Schools Co-operative Projects - Evaluation of Pilot Studies of Classroom Use of the Hand Calculator in Grades 4-6. Phase II, September 1975 to June 1976. Mt. Clemens, Michigan: Macomb Intermediate School District, 1976.

This report includes the fundamental components of the design of the research project and data interpretation supporting the use of calculators as an instructional aid in the classroom.

[Elementary (grades 4-6), Research (field study)]

Caravella, Joseph R. A Consumer's Guide to Minicalculators. Washington: National Education Association, 1976.

(See also: Caravella, Joseph R. Selecting a Minicalculator. Arithmetic Teacher 23: 547-550; November 1976.)

(See also: Caravella, Joseph R. Computing Devices. Mathematics Teacher 70: 360-363; April 1977.

Checklists are provided which are designed to help educators select an appropriate calculator for particular situations.

[Selection]

Caravella, Joseph R. Minicalculators in the Classroom. Washington: National Education Association, 1977. ERIC: ED 134 474.

The positive contributions of the calculator to basic education are explored. The introduction discusses questions educators ask about the use of the calculator. The first section briefly describes uses of the calculator in the classroom, discusses research on calculators, describes NCTM involvement, and presents the NACOME recommendations concerning calculators. The second section covers the implications of the use of the calculator in terms of curriculum, teacher in-service education, classroom management, instruction, and testing and evaluation. The third section gives guidelines for

selecting and using calculators. The final section includes classroom activities keyed to the various functions of the calculator.

[Activities, Classroom management, Roles, Selection, Status report]

Carman, William. Calculator Assisted Individualized Instruction. West Virginia Council of Teachers of Mathematics Newsletter 3: 17-18, 1978.

[Activities]

Carney, Richard. Your Electronic Hand Calculator. How to Get the Most Out of It. New Brunswick: Rutgers, the State University, September 1978. ERIC: ED 159 480.

For students at beginning high school through adult levels, this manual contains 17 lessons on uses of calculators, with objectives, procedural information, examples, and problems to be solved.

[Activities, Mixed operations, Post-secondary, Roles, Secondary, Units]

Carter, Juanita E. and Young, Darroch F. Calculating Machines: A Ten-Key Approach. New York: Houghton Mifflin, 1975.

[Business education]

Cech, Joseph Philip. The Effect the Use of Desk Calculators Has on Attitude and Achievement in Ninth-Grade General Mathematics Classes. (Indiana University, 1970.) Dissertation Abstracts International 31A: 2784; December 1970.

(See also: Cech, Joseph P. The Effect of the Use of Desk Calculators on Attitude and Achievement with Low-Achieving Ninth Graders. Mathematics Teacher 65: 183-186; February 1972.

The two main reasons for using calculators with low achievers in mathematics classes are motivation and achievement. This study of calculator effectiveness involved two teachers each teaching a calculator section and a regular section of general mathematics for seven weeks. Students in the experimental group were encouraged, but not forced, to check answers with the calculators. All classes were given pre- and posttests of attitude and achievement. Results did not support the hypothesis that students using calculators would show positive gains in attitude toward mathematics, or increased paper-and-pencil computational skill. Students could compute better with the calculator than without it, however.

[Attitudes, Desk calculators, General mathematics, Low achievers, Research, Secondary (grade 9)]

Champion, R. R. Talking Calculator Used with Blind Youth. Education of the Visually Handicapped 8: 102-106; Winter 1977.

[Handicapped (blind)]

Chaney, Larry. A Program That Works: Calculator Lab at Woodview Junior High. Terre Haute, Indiana: Indiana State University, 1977.

[Activities]

Channell, Dwayne E. The Use of Hand Calculators in the Learning of Basic Multiplication Facts. Columbus: The Ohio State University, May 1978. Xerox copy. 8 pp.

This "informal study" investigated the effectiveness of using calculators as an immediate feedback device in learning some basic multiplication facts. One class of 26 second graders was given a pretest of 20 facts, with about five seconds allowed for each response. Seven days of classroom instruction by the regular teacher involved nine textbook pages plus activities using physical and pictorial models. Students also practiced for 8 to 10 minutes on 6 days, using calculators to check immediately their recall on each combination (but not using other materials). The set of 20 facts was given again. The mean increased from 6.37 to 12.16. The largest gain in recall occurred on those facts practiced on the calculator alone; the smallest gain was on those facts presented by the textbook alone.

[Achievement, Elementary (grade 2), Multiplication (facts), Research]

Chassen, Howard. "Handy-Andy" Calculator Project 1976-77. Bethpage, New York: Bethpage Union Free School District, June 1977. Xerox copy.

One of four "average" sixth-grade classes (with a teacher who had shown a high level of interest) was selected to work with calculators. The Wide Range Arithmetic Test was administered to all four classes in September 1976 and as a posttest in June 1977. Each student in the pilot class was provided with a four-function calculator with square root key. Students were permitted to use the calculators whenever "they felt the need." Standardized and major class tests were taken without calculators; however they were used in classroom and homework assignments. Decimal fractions were introduced as an outgrowth of whole number operations; fractions were presented later. The teacher reported an extremely high level of enthusiasm throughout the school year. Using a regression formula and a correlated one-tail t test, the pilot group was found to achieve beyond expectation ($p < .01$). Pilot group gain was 2.6, compared with 1.0, 1.1, and 1.0 gains by other classes.

[Achievement, Elementary (grade 6), Four-function calculators, Research]

Chinn, William G.; Dean, Richard A.; and Tracewell, Theodore N. Arithmetic and Calculators: How to Deal with Arithmetic in the Calculator Age. San Francisco: W. H. Freeman & Co., 1978.

The calculator is used as a teaching tool, with arithmetic processes developed through the use of the calculator. A variety of real-world applications and mathematical recreations are included.

[Activities, Mixed operations]

Clark, C. J.; Kuemmerle, E. W.; and Lieto, L. R. Programmable Calculators: Uses in Freshman Chemistry Laboratories. Journal of Chemical Education 52: 423; July 1975.

Two uses for the programmable calculator in the laboratory are suggested: as a means of determining whether a student's raw data from a laboratory experiment fall within acceptable tolerance limits, and as a means of checking the reliability of unknowns and grading on quantitative experiments.

[Chemistry, College, Programmable calculators]

Clark, Hyla and Barandes, Larry. Desktop Calculators That Print Their Results. Popular Mechanics 147: 187-189; April 1977.

Advantages of printing calculators are discussed. Consumer concerns (such as power source, types of display, noise factors, special keys, memory) are identified. Four printing calculator models are described in detail.

[Desk calculators, Selection]

Clarke, John. Educational Technology. Mathematics in School 1: 30-31; November 1971.

Principles on which the use of educational technology is based are discussed.

[Elementary, Secondary, Roles]

Clarke, John. Mathematical Game 16: Reversal. New Zealand Mathematics Magazine 15: 50-51; September 1978.

[Games]

Clarke, Ray. Calculating Aids. New Zealand Mathematics Magazine 15: 9; May 1978.

Some arguments against using calculators are countered.

[Pros/cons]

Clyde, Donald. Recycle the Tin Can Problem. Calculators/Computers 2: 35-44; February 1978.

A worksheet specifically for use with calculators is included in the presentation of the problem.

[Problem solving, Worksheets]

Cohen, David B. Another Way of Finding Prime Numbers. Mathematics Teacher 69: 398-400; May 1976.

A method of finding large primes using calculators or computers is presented.

[Prime numbers]

Comarow, Avery. Practical New Uses for Pocket-Money Calculators. Money 13: 88-91; October 1974.

Different models of pocket calculators are compared, and some ways to use the calculator to solve business-oriented problems such as compound interest and taxes are presented.

[Business, Consumer applications, Selection]

Comarow, Avery. Maximizing Your Minicalculator. Money 14: 52-53; January 1975.

The total number of pocket calculators sold in the U.S. in 1974 probably exceeded 13 million. To be reasonably flexible for household uses, calculators should have separate keys for +, -, x, ÷, and =, a floating decimal point, and a display of at least eight digits. Methods for basic calculations, computation of interest, and anticipating monthly payments are presented in step-by-step formats.

[Consumer applications, Marketing, Selection]

Consumer Bulletin

55: 14-18; September 1972. (Adding and Calculating Machines.)

56: 15-19; May 1973. (Electronic Calculators.)

Features, prices, and ratings are included in these reports.

[Selection]

Consumer Reports

38: 372-377; June 1973. (Electronic Mini-calculators.)

38: 663; November 1973.

40: 533-541; September 1975. (Calculators.)

41: 86-87; February 1976. (Scientific Calculators.)

42: 5-6; January 1977. (New Calculator Virtues; Long Life, Tiny Size.)

42: 561; October 1977. (Two Compact Calculators with Long Battery Life.)

42: 620; November 1977. (Pocket-Sized Solar Power? Just Expensive Gadgetry.)

[Selection]

Consumers Research Magazine

57: 7-12; September 1974. (Electronic Pocket Calculators.)

58: 19; January 1975. (Electronic Pocket Calculators.)

58: 13-16; April 1975. (Pocket-size Electronic Calculators.)

58: 65-66; October 1975. (Office at Home Products.)

59: 150-152; October 1976. (Office at Home Products.)

59: 7-12; December 1976. (Scientific and Printing Calculators.)

60: 175-177; October 1977. (Electronic Calculators.)

60: 33-36; November 1977. (Some More Calculators.)

61: 21-25; September 1978. (Low Priced Calculators.)

Characteristics and ratings of calculators are given.

[Selection]

Coons, David F. A Concise Method for Computing Normal Curve Areas Using a Calculator. Educational and Psychological Measurement 38: 653-655; Fall 1978.

A concise method for computing areas under the normal curve using only functions typically found on desk and hand calculators is given. One version of this method will give three-decimal-place accuracy; a second, simpler version gives accuracy to two places.

[College, Statistics]

Cooper, Annette J. An Analysis of the Effect of the Use of a Hand-held Calculator on Attitude and Achievement in Selected College Algebra Classes. (Oklahoma State University, 1977.) Dissertation Abstracts International 39A: 85; July 1978.

At four two-year colleges, two control groups were conducted in spring 1975 and fall 1975, and two corresponding experimental groups in fall 1975 and spring 1976. Four teachers each taught a control group and, the following semester, an experimental group (using calculators). No significant differences in attitude or achievement were found between corresponding groups using or not using calculators.

[Achievement, Attitudes, College, Research]

Cooper, R. F. The Talking Calculator. Mathematics Teaching 77: 45; December 1976.

Computation problems are presented which will result in phrases that can be read from the calculator's display.

[Activities]

Coward, P. H. Electronic Calculators and Arithmetic: Two Investigations. 2. Electronic Calculators in Further Education. Mathematics Teaching 82: 26-28; March 1978.

The same sample of 414 college students was tested twice, first without calculator and then, after one week, with a calculator. The one-hour test consisted of 40 arithmetic calculations, from engineering, business, and other sources. The posttest mean (27.19) was 67 percent better than the pretest mean. It appeared that the least able groups arithmetically gained most from use of the calculators. An attitude scale was also administered, with comments of 52 respondents discussed.

[Achievement, Attitudes, College, Research]

Cox, B. R. Mathematics Council Calculator Activities for Intermediate Mathematics Teachers. Cincinnati, Ohio: Princeton City School District, Mathematics Instructional Council, August 1977.

Thirty activity worksheets and materials for use in a work session for teachers are included in this packet.

[Teachers (in-service), Worksheets]

Craver, W. Lionel, Jr. Pocket Calculators and Classroom Testing. Educational Research and Methods 8: 72; Spring 1976.

The problems that arise in test situations when some, but not all, students use calculators are discussed, and some solutions to these problems are suggested.

[College, Testing]

Crothamel, David A.° A Calculator Project for Elementary Functions and Statistics Classes. Calculators/Computers 2: 79-85; March 1978.

This project, which can be carried out in any junior or senior mathematics class with at least one calculator with an exponential function, is described in terms of the elementary function aspect, the statistical aspect, describing the data, fitting the curve, and a summary.

[Functions, Scientific calculators, Secondary (grades 11-12), Statistics]

Curtis, Judith. Calculators Count More in Class. Electronics 50: 86-87; April 14, 1977.

The trend toward the greater use of calculators in schools is described.

[Roles]

D'Ambrosio, Ubiratan. Issues Arising on the Use of Hand-Held Calculators in Schools. 1977. ERIC: ED 144 814.

(See also: International Journal of Mathematical Education in Science and Technology 9: 383-388; 1978.

The use of calculators is considered from pedagogical and sociological viewpoints. The effects of adoption of calculators in developing countries and for deprived minorities is noted, and the role of calculators in problem solving is discussed.

[Pros/cons, Roles]

D'Ambrosio, Ubiratan. El Impacto de las Calculadoras de Bolsillo en la Educacion Cientifica y en Particular en la Ensenanza de las Matematicas. Boletin Informativo de la Educacion Matematica No. 1, November 1978. Provincia Del Chaco, Ministerio de Gobierno, Justicia y Educacion, Direccion de Documentacion e Informacion, Brazil.

[Roles]

D'Ambrosio, Ubiratan. Um Exemplo Sobre A Estrategia De Curriculo E Integrado No Ensino Da Matematica. (An Example of a Strategy of the Integrated and Dynamic Curriculum in the Teaching of Mathematics.)

The use of the hand calculator to make mathematical analysis more efficient is suggested and an example (square roots) of a problem where a calculator can be used as a computational tool is given. It is suggested that the calculator be used in Polya-type problem-solving situations.

[College, Problem solving, Roots]

D'Ambrosio, Ubiratan. Uma Introducao Nao Classica A Analise Classica. (A Non-Classical Introduction to Classical Analysis.)

A brief discussion of the history of mathematics up through the development of the calculator in the 1960s is given. The author

stresses that we should begin to face the educational and attitudinal problems posed by the rapid increase in the technological advancement of calculators. (Children may learn to use calculators before learning to read and write.) He suggests that in-service courses for teachers be developed to give them examples of calculator use. Examples given include calculator use with summing a series, approximating functions, and evaluating a Taylor series expansion.

[Activities, College, History, Roles]

D'Ambrosio, Ubiratan. Aproximacion De Funciones Por Funciones Lineales: Nocion De Derivada. (Approximation of Functions by Linear Functions: The Concept of Derivative.)

Differential calculus can be approached through the observation and study of natural phenomenon. The calculator can be used instead of hand calculating to obtain more accurate approximations for functional values.

[Calculus, College]

D'Ambrosio, Ubiratan. A Mini-Calculadora Como Auxiliar Do Ensino Da Matematica, No. 1' Grau. (The Mini-Calculator as an Aid to Teaching Mathematics, Level 1.)

The speed and efficiency of the calculator can aid in the learning of mathematics by allowing students more time to understand the structure of the problem. This is the rationale used in proposing a study with hand calculators in the study of powers and radicals by students aged 14-17. Several calculators are reviewed and a timetable for the proposed study is given. Test questions written toward stated objectives are also included.

[Problem solving, Research, Secondary]

D'Aulaire, Emily and D'Aulaire, Ola. Put a Computer in Your Pocket. Reader's Digest 107: 115-118; September 1975.

Reasons for buying a calculator are included in this article.

[Roles, Selection]

Davidson, James J. Calculators As Recreation. Calculators/Computers 2: 17-18; March 1978.

A reason for the popularity of calculator games is discussed: "a calculator game, then, is a simple but challenging vehicle by which a quantitative mind can play directly with the objects of its affection--numbers--regardless of the amount of mathematical skill."

[Games]

Davidson, Jessica. 2, 4, 6, 8--Let's Start to Calculate. New Rochelle, New York: Cuisenaire Company of America, 1976, 1978.

Activities designed for students in grades 5 through 9 focus on reinforcing the important principles involving decimal numbers and operations and on motivating investigations in number theory.

[Activities, Elementary (grades 5-6), Junior high (grades 7-9), Worksheets]

Davies, Pauline. Problem Solving Experiences with a Calculator, Calculators/Computers 2: 22-24; May 1978.

Suggestions for using calculators in solving word problems are presented for students in grade 5.

[Elementary (grade 5), Problem solving]

de Cortex, Esther Elicha. Estudio de los Numeros Racionales, en Forma Experimental con un Modulo de Alumnos de Doce Anos de Edad, de la Ciudad de Panama. December 1976. (A Study of Rational Numbers in an Experimental Form with Twelve-Year-Old Pupils of Panama City.)

This article is a proposal to study the use of calculators with elementary school pupils during a study of rational numbers. The author assumes that secondary students cannot handle rational numbers, that calculators will help students to understand rational number concepts, and that the calculator decreases computational time so that more time can be spent increasing logical thinking skills.

[Elementary, Rational numbers, Research]

Deeson, Eric. The Electronic Calculator. Physics Education 9: 419-421; September 1974.

Features of calculators such as precision and constant keys are briefly discussed.

[Selection]

DeJong, Kees A. Electronic Calculators Facilitate Solution of Problems in Structural Geology. Journal of Geological Education 23: 125-128; September 1975.

Three general types of applied problems in structural geology are discussed and trigonometric solutions are indicated. In addition, a five-example problem set is included.

[College, Problem solving, Science (geology), Trigonometry]

Del Seni, Donald L. Use of Hand Calculators in Mathematics Instruction. Summation 21: 5-6; Fall 1975. (Association of Teachers of Mathematics of New York City.)

[Roles]

Denman, Theresa. Calculators in Class. Instructor 83: 56-57; February 1974.

The author comments on the fact that calculators are fast becoming accepted as necessary household appliances. When the children in school today are adults, they will look on calculators as being as necessary to everyday life as telephones.

[Roles]

De Quetroz, Olnei-Freire. Una Tentativa de Introducao da Calculadora Electronica na Escola de 1' Grau Como Instrumento de Ensino. Universidade Estadual de Campinas, Instituto de Matematica, Estatistica e Ciencia da Computacao, Curso de Mestrado em "Ensino de Ciencias e Matematica" (Professor Doutor Ubiratan D'Ambrosio), November 1977.

[Curriculum]

Dodge, C. W. Problem and Solution. American Mathematical Monthly 83: 136-137; February 1976.

A solution is given to the problem, "Given a calculator with no memory, but with a squaring key, find the smallest power of n that cannot be computed without entering the value of n at least k times in the keyboard."

[College, Problem solving]

Dohleman, L. What to Look For in an Electronic Calculator. Business Education Forum 27: 32-33; March 1973.

Features to consider when buying calculators for business or business education purposes include output type, decimal control, automatic rounding, portability, and programmability. It is suggested that buyers know terminology pertaining to the machine and test machines with the types of problems to be used in class.

[Business education, Selection]

Dolan, Daniel T. Let's Calculate: Instructional Guide for Your Calculator. San Leandro, California: Lakeshore Curriculum Materials Co., 1976.

The first half of this guide gives detailed instructions for the functions of the Lakeshore Basic School Calculator. The second half of the book provides supplemental materials and activities.

[Activities, Elementary (grades 4-6), Four-function calculator, Junior high (grades 7-8)]

Donner, Michael and Matus, Lynn. Calculator Games. New York: Golden Press, 1977.

[Games]

Downes, John P.; Jensen, Rosalie S.; and Johnson, Hiram D. 76 Questions: A Synthesis of the Research on Teaching and Learning Mathematics. Atlanta: Georgia Department of Education, December 1977. ERIC SE 025 422.

One brief section considers research on calculators.

[Research (review)]

Drake, Paula M. Calculators in the Elementary Classroom. Arithmetic Teacher 25: 47-48; March 1978.

Using calculators to check work is discussed.

[Checking]

Dubisch, Roy and Hood, Vernon R. Basic Mathematics with Hand-held Calculator: A Work-Text. Menlo Park, California: Benjamin/Cummings Publishing Company, 1979.

This worktext is for students at either secondary or college level.

[Basic mathematics, College, Secondary]

Ducharme, Robert. Computers (and Students!) Need Explicit Notation. Mathematics Teacher 71: 448-451; May 1978.

Examples of notational problems are cited, to point out the need for "a complete and consistent set of explicit operators."

[Notation]

Dunlop, David L. Solitaire Mastermind with Programmable Hand Calculators. Calculators/Computers 2: 31-36; May 1978.

This game, programmed for an HP-25, can be modified for use with other programmable calculators. Using deductive logic, one or two players attempt to determine the code. Two programs (with variations) and a recording sheet are given.

[College, Games, Programmable calculators, Secondary]

(Durham.) The Use of Electronic Calculators in Secondary Schools. Durham: County of Durham Education Committee, Darlington Teachers' Centre, 1976.

Considered are types of calculators and uses of those calculators. Descriptions of the ways in which calculators are being used in the various schools involved in the project are provided.

[Activities, Research, Roles, Secondary, Selection]

Durrance, Victor Rodney. The Effect of the Rotary Calculator on Arithmetic Achievement in Grades Six, Seven, and Eight. (George Peabody College for Teachers, 1964.) Dissertation Abstracts International 25: 6307; May 1965.

From grades 6-8 in a single school, 35 pairs of students were matched according to IQ and grade placement in arithmetic. One from each pair was then selected to use the calculator. Analysis of data from the nine-week study indicated that in computation, reasoning, and concepts, the calculator had no effect except in the area of reasoning in grade 7.

[Achievement, Desk calculators, Elementary (grade 6), Junior high (grades 7-8), Research]

Dyce, Byron Alphonso. The Effect of Incorporating the Mini- or Hand-held Calculator into a Community/Junior College Basic Mathematics Course. (The University of Florida, 1977.) Dissertation Abstracts International 39A: 43; July 1978.

Four basic mathematics classes at one college used calculators. They were administered pre- and posttests of achievement and

attitude. A linear regression procedure indicated that "there was insufficient evidence to conclude that there was any particular advantage to using mini-calculators." No positive correlation was found between changes in achievement and in attitudes toward mathematics.

[Achievement, Attitudes, Basic mathematics, College, Research]

Eckmier, Janice Logan. An Investigation of the Use of Calculators with Low Achieving 4th Grade Students in Mathematics Achievement and Attitude. (University of Southern California, 1978.) Dissertation Abstracts International 38A: 7109; June 1978.

This study investigated the effects of hand-held calculators on achievement and attitudes toward mathematics at three levels of socioeconomic status. Six classes of low-achieving fourth graders participated from September to June, with an experimental and a control classroom at each of three SES levels. The experimental group used calculators in addition to the regular textbook, while the control groups used only the textbook. The experimental groups were assigned only 50 percent of the paper-and-pencil work completed by the control groups; the remaining time was used to check mathematics problems done by hand, as well as to do other calculator problems. No significant differences in achievement or attitude gains were found.

[Achievement, Attitudes, Elementary (grade 4), Low achievers, Research]

Edsall, E. L. Some Possible Effects of Calculators on Secondary School Mathematics. Spectrum 16: 28-30; October 1978.

[Secondary]

Edsall, D. L., et al. Calculators Have Come. England: The Mathematical Association, 1976.

[Activities, Roles]

Edwards, Craig. Calculator Activities. Mathematics in Michigan 18: 22-24; September 1978.

Nine problem sets, involving "real-life" situations, are included.

[Problem solving]

Egbert, W. E. Personal Calculator Algorithms (1) Square Roots. Hewlett-Packard Journal 28: 22; No. 9, 1977.

[Roots]

Egbert, W. E. Personal Calculator Algorithms (2) Trigonometric Functions. Hewlett-Packard Journal 28: 17; No. 10, 1977.

[Trigonometry]

Egbert, W. E. Personal Calculator Algorithms (3) Inverse Trigonometric Functions. Hewlett-Packard Journal 29: 22; No. 3, 1977.

[Trigonometry]

Eimer, Rebecca A. Cube Roots on a Calculator. Mathematics Teacher 70: 175; February 1977.

(See also: Reader Reactions--nth Roots on a Calculator. Mathematics Teacher 70: 645; November 1977.)

An algorithm is given for using a calculator to compute the cube root of any real number.

[Roots]

Eisberg, Robert M. Applied Mathematical Physics with Programmable Pocket Calculators. New York: McGraw-Hill, 1976.

Designed as a supplement to existing physics texts for the calculus-based course, this guide for using calculators with programmable capabilities presents a series of programs that enable students to treat key topics in physics.

[College, Physics, Programmable calculators, Programming]

Eisberg, Robert. Programmable Pocket Calculators in College Science Teaching. Journal of College Science Teaching 7: 305; May 1978.

The use of programmable calculators to solve second-order differential equations is described in an article which consists of examples selected by the author from his 1976 book.

[College, Physics, Programmable calculators]

Eisberg, Robert and Hyde, Wendell. COUNTDOWN: Skydiver, Rocket, and Satellite Motion on Programmable Calculators. Portland, Oregon: Dilithium Press, 197 .

[Programmable calculators, Science]

Elder, Mary C. Mini-Calculators in the Classroom. Contemporary Education 47: 42-43; Fall 1975.

Student discoveries about numbers and operations, stemming from the use of a calculator, are described.

[Elementary, Roles]

Ellis, June and Corum, Al. Functions of the Calculator in the Mathematics Laboratory for Low Achievers. 1969. ERIC: ED 040 847.

An experimental and a control class were administered pre- and posttests to check the effects of calculator use on the achievement, attitude, and academic motivation of low achievers. The use of printing calculators did not produce a statistically significant change in mathematics achievement. More favorable attitudes and weaker academic motivation were recorded for both groups at the end of the experiment.

[Achievement, Attitudes, Desk calculators, Low achievers, Research, Secondary]

Engel, Arthur. Computerorientierte Mathematik. Der Mathematikunterricht, February 1975.

[Roles]

Engel, Arthur. The Role of Algorithms and Computers in Teaching Mathematics at School. In New Trends in Mathematics Teaching, Volume IV. Paris: UNESCO, 1978.

This is the report from the Third International Congress on Mathematics Education, Karlsruhe, 1976.

[Algorithms, Roles]

Engel, C. William. Meet Minnie Calculator! In Fostering Creativity Through Mathematics (Betty K. Lichtenberg and Adria P. Troutman, editors). Tampa: Florida Council of Teachers of Mathematics, 1974. Pp. 69-77.

Appropriate topics and activities are suggested for using the calculator at a variety of levels.

[Activities, Elementary, Secondary]

Engelson, Harold S. Programming Programmable Calculators. Rochelle Park, New Jersey: Hayden Book Co., Inc., 1978.

[College, Programmable calculators, Programming]

Ethelberg-Laursen, J. Electronic Calculators and Arithmetic: Two Investigations. 1. An Experiment in Danish Schools. Mathematics Teaching 82: 24-25; March 1978.

Four classes of 8-year-olds were selected from six schools as an experimental group, one doing tradition arithmetic and three doing modern mathematics, with a similar four classes and six additional classes acting as control groups. All classes were given a test in "the 100 number bonds." Machines were used "on equal terms with other teaching materials, for checking addition and subtraction, and for solving problems using realistic numbers." Multiplication was taught as repeated addition, with the multiplication key not used until later. Amount of use varied by teacher. At the end of the year, all classes were tested on addition, subtraction, and multiplication, both mechanically and in problems, without using calculators. The calculator group achieved at least as well as the control group, with greater speed and accuracy.

[Achievement, Elementary, Mixed operations, Research]

Etlinger, Leonard. The Electronic Calculator: A New Trend in School Mathematics. Educational Technology 14: 43-45; December, 1974.

The existence of low-cost calculators is not sufficient justification for their use in mathematics programs. Proponents of calculator use in schools generally have one of two contrasting views. The functional position advocates the use of the calculator to perform computations, obviating the need to teach computation. The basic tenet of the pedagogical position is that the calculator can facilitate (rather than replace) learning. The implications of this point of view and the potential pedagogical value of the calculator are not yet known, and many specific questions need answers. Examples of the pedagogical use of calculators are described.

[Pros/cons, Roles]

Etlinger, Len and Vitale, Marie. Calculator Activity Book: Motivating Activities to a Greater Understanding of Mathematics. Chicago: Educational Teaching Aids, 1977.

Intended for elementary and junior high students, these activities are organized in five categories: warm-up computation exercises, generating a given number by repeated use of specified digits and operations, functions and relations, number patterns, and work problems.

[Activities, Elementary, Junior high]

Ewing, Galen W. (Editor). Topics in Chemical Instrumentation. Journal of Chemical Education 52: 346-350; July 1975. 52: 373-379; August 1975.

The first article surveyed the range of electronic calculators available, along with their capabilities. The second article provided specifications on desk calculators.

[Selection]

Favre, Pierre. Des calculatrices et l'enseignement des mathematiques. Paper from Seminaire CIEN, Luxembourg, July 1978.

[Roles]

Feder, Chris Welles. Children and Calculators: Do They Add Up? McCall's 102: 34; May 1975.

Some uses of calculators in schools in East Greenbush, New York; Virginia, and Brooklyn are described.

[Roles]

Fehr, Howard F.; McMeen, George; and Sobel, Max. Using Hand-Operated Computing Machines in Learning Arithmetic. Arithmetic Teacher 3: 145-150; October 1956.

A controlled experiment on learning multiplication by using a two-digit multiplier was conducted for a two-week period. No significant difference was found in the performance of students in experimental and control groups. However, the experimenters felt that longer use of the devices might have produced an effect, and therefore conducted a half-year experiment using the Monroe Educator model hand-operated calculator. Students using this machine made significant gains in both computation and reasoning. Although their gains were greater than those of a control group, these differences were not statistically significant. Both students and teachers using calculators had a very positive attitude toward calculator use in the mathematics classroom.

[Achievement, Attitudes, Desk calculators, Elementary (grade 5), Multiplication, Research]

Feldzamen, A. N. and Henle, Faye. The Calculator Handbook. New York: Berkley Publishing Co., 1973.

This book gives the layman an introduction to the pocket calculator. It includes tips on how to use the calculator to solve everyday problems such as uses in shopping and computing taxes.

[Consumer applications]

Ferguson, S. New Roots for Old. Mathematics Teaching 78: 60-61; September 1978.

A procedure for taking cube and other roots is given.

[Roots]

Ferreira, Mario Lucio da Costa. Uma Tentativa de Introducao da Mini-Calculadora Electronica na Escola de Primeiro Grau, Como Instrumento de Ensino. Curso de Mestrado em Ensino de Ciencias e Matematica Convento/OEA/Premen/IMECC (Professor Doutor Ubiratan D'Ambrosio), November 1977.

[Curriculum]

Fesharaki, Mahammad. A Study of the Effect of Hand-Calculators on Achievement, Estimation and Retention of Seventh and Eighth Graders on Decimals and Percent. (University of Missouri-Columbia, 1978.) Dissertation Abstracts International 39A: 6004; April 1979.

Students from four mixed seventh- and eighth-grade classes participated. After categorization into high, middle, and low achievement levels, classes were assigned to two teachers. Each teacher taught one calculator and one non-calculator class for 30 class periods. The findings indicate that students using calculators and developed calculator materials demonstrated significantly greater gains than did non-calculator students, on measures of decimals and percent. No differences in retention were found in achievement or estimation skills.

[Achievement, Decimals, Estimation, Junior high (grades 7-8), Percent, Research]

Field, R. Science and the Consumer: Figuring Pocket Calculators. Science Digest 77: 85-86; March 1975.

Ways in which the calculator can aid the consumer are discussed.

[Consumer applications]

Field, Roger. Endangered Species: The Slide Rule. Science Digest 81: 68-69; March 1977.

The calculator's effect on sales of slide rules is briefly discussed.

[Marketing, Slide rule]

Fielker, David. Electronic Calculators: A Changing Situation. Mathematics Teaching 65: 28-32; September 1973.

Electronic calculators are here to stay, and far-sighted schools are beginning to be interested in them. As they become more popular it will be difficult to justify teaching as much rote arithmetic as is common. Computing devices of the past have often been effective because they involve tactile and visual experience of mathematical operations; electronic calculators do not afford one this experience. Use of the hand calculator in schools will require emphasis on place value, magnitude, and notation. Some advantages of the machines are the ability to handle large numbers, their usefulness for activities such as estimating square roots, and the possibility of using them in the design of new algorithms. Some advice on the purchase of calculators and a glossary of calculator-related terms is included in this article.

[Pros/cons, Roles, Selection]

Fielker, David S. Using Electronic Calculators. Mathematics Teaching 76: 14-19; September 1976.

Classroom management problems arising from using calculators are briefly discussed. Several mathematics activities are suggested.

[Activities, Classroom management, Elementary, Secondary]

Fielker, David. The Latest on Calculators. Mathematics Teaching 77: 42-44; December 1976.

Use of calculators during examinations is discussed. Information concerning the capabilities of nine desk-top calculators is provided, and five hand-held calculators which deal with fractions are described. Three books on calculators are also reviewed.

[Desk calculators, Elementary, Four-function calculators, Secondary, Selection, Testing]

Findley, Robert Earl. An Evaluation of the Effectiveness of a Textbook, Advanced General Math, Used by Ninth Grade General Mathematics Classes. (Colorado State College, 1966.) Dissertation Abstracts International 27A: 2440-2441; February 1967.

The group using the traditional textbook and calculators for a full year gained significantly more than the group using the traditional textbook alone or the modern textbook with calculators, but only on arithmetic fundamentals achievement.

[Achievement, Desk calculators, Research, Secondary (grade 9)]

Fischman, Myrna Leah. New York City High School Students' Attitudes and Concept Learnings in Business Arithmetic When Using Electronic Calculators as Contrasted with Hand Calculation. (New York University, 1976.) Dissertation Abstracts International 37A: 774-775; August 1976.

Three business arithmetic classes of ninth and tenth graders used calculators while three other business arithmetic classes did not.

All classes were taught the same material. No significant in attitudes toward business mathematics or in understanding of concepts were found for the calculator vs. the non-calculator group. However, the calculator group scored significantly higher on a test of arithmetic skills than did the non-calculator group.

[Achievement, Attitudes, Business mathematics, Research, Secondary (grades 9-10)]

Fitzgerald, A. Mathematical Knowledge and Skills Required by Pupils Entering Industry at the 16+ Level. Mathematics in School 5: 22-23; May 1976.

The mathematical needs of students entering technical occupations after secondary school are discussed. Forty-four competencies are listed. Among a number of questions raised is whether the availability of calculators will affect these present basic mathematical competencies needed by workers.

[Post-secondary, Technical occupations]

Fletcher, Trevor J. Avoiding Errors in Arithmetic. Mathematics Teaching 77: 34-41; December 1976.

The place of binary arithmetic in the curriculum is discussed, then uses of binary coding for methods of automatic error correction in computers and calculators are analyzed.

[Nondecimal bases]

Forbes, Milton L. Simulation of Natural Selection on the Programmable Calculator. Journal of College Science Teaching 8: 95-96; November 1978.

A model or game is described which enables students to experiment with equilibria and to trace rapidly gene frequency changes through time under postulated conditions of selection.

[College, Games, Programmable calculator, Science]

Frandsen, Henry. Calculator Workshop for High School Teachers (Second Edition). Knoxville, Tennessee: Mathematics Department, University of Tennessee, February 1976.

[Course description, Teachers (in-service)]

Fraser, Marshall. Elementary Algebra (Hand Held Calculator Edition). Palo Alto, California: Page-Ficklin Publishing Co., 1976.

[Algebra]

Free, J. R. P.S. Buyers Guide to Under \$100 Electronic Calculators. Popular Science 202: 86-88, 156; March 1973.

Several types of calculators and their distinctive features are described.

[Selection]

Free, John R. Now There's a Personal Calculator for Every Purse and Purpose. Popular Science 206: 78-81; February 1975.

Features and functions for 37 models are tabulated.

[Selection]

Free, J. R. Those Incredible New Scientific Pocket Calculators. Popular Science 204: 124-125; April 1975.

Ways in which the calculator can be used are discussed.

[Roles]

Free, John. Specialized Calculators--Preprogrammed to Solve Problems Faster. Popular Science 209: 58-60; November 1976.

Advantages of preprogrammed calculators are discussed, and several models are described. Features of business or financial calculators are mentioned.

[Business, Programmable calculators, Selection]

Free, John. Those Work-Saving, Time-Saving, Problem Solving Programmable Calculators. Popular Science 210: 64, 66, 70; February 1977.

Three groups of programmable calculators are identified: key programmable (volatile memory), card programmable, and key programmable (non-volatile memory). (Volatile memories are erased and lose the program when the power is shut off.) Eleven calculators are compared on the following features: program steps, branching, addressable memories, logic, stack registers (reverse Polish notation), parenthesis levels, pending operations (algebraic operating system), and price. Two programs are given.

[Programmable calculators, Programming, Selection]

Free, J. Specialized Calculators Shortcut Tough Problems. Popular Science 210: 171; June 1977.

[Selection]

Free, John. Pocket Calculators For More Than Math. Popular Science 214: 22ff; April 1979.

Some features and some weaknesses of liquid display calculators are discussed.

[Selection]

French, Doug. A Square Root Algorithm. Mathematics Teacher 79: 35; June 1977.

An algorithm for calculating square roots on the Casio Memory 8 calculator is given.

[Roots]

Frenzel, Louis E., Jr. Ninety-Nine Ways to Know and Use Your Electronic Calculator. Indianapolis: Howard W. Same & Co., 1975.

[Activities, Consumer applications]

Friedlander, Richard J. Efficient Algorithms for the Calculator. Mathematics Teacher 71: 614-618; October 1978.

A brief discussion of calculator logic is followed by descriptions of efficient algorithms for reciprocals, powers, and parentheses.

[Algorithms, Calculator logic, Powers, Reciprocals]

Friesen, Charles D. Check Your Calculator Computations. Arithmetic Teacher 23: 660; December 1976.

A number-word puzzle to be solved on the calculator is presented.

[Activities]

Fritz, Don. Calculating Devices (Units). Austin, Texas: L.B.J. High School, Summer 1975.

This is a one-quarter (12 weeks) course for remedial grade 9 students who have not mastered the fundamental operations. The course has been in the curriculum for five years, and supports efforts to have all students proficient in basic mathematics skills.

[Course description, Remedial, Secondary (grade 9)]

Frye, J. T. Versatile Pocket Calculators. Electronics 1: 58-61; May 1972.

Some of the applications for calculators are discussed.

[Consumer applications]

Frye, J. F. Buying and Using a Pocket Calculator. Popular Electronics 5: 62-64; May 1974.

Some common-sense things to look for when buying an electronic calculator are given. Some algorithms are also presented, for use with the less expensive calculators which do not have all capabilities built in.

[Algorithms, Selection]

Frye, John T. Selecting a Calculator. Popular Electronics 8: 94-96; December 1975.

Who will use the calculator and for what purpose, how much mathematics the user has or will study, and how much the buyer wants to pay should be considered when purchasing a calculator.

[Selection]

Gallery, Michael Edward. Teaching Calculator Use and Checking Account Skills to the Mildly Handicapped. (Utah State University, 1978.) Dissertation Abstracts International 39A: 2866; November 1978.

Two "packages" on calculator skills and on checking account skills were evaluated with 38 students from six high schools and two junior high schools. Eighteen students received instruction on the packages, while 20 students were in the control group. A one-way analysis of variance indicated that the difference between group posttest means for both packages significantly favored the experimental group. However, the mastery criterion was not achieved on either package.

[Handicapped, Junior high, Research, Secondary, Units]

Gardner, Martin. Mathematical Games: Fun and Serious Business with the Small Electronic Calculator. Scientific American 235: 126-129; July 1976.

A cryptarithm, activities involving limits, a keyboard game, and several number tricks to be done on a calculator are described and explained.

[Activities, Games]

Garner, Lou. The Great Guessing Game. Popular Electronics 11: 85-93; January 1977.

Predictions involving the production of calculators in 1976 are verified, and new predictions for 1977 are made.

[Marketing]

Garst, John F. Grade Analysis with a Programmable Pocket Electronic Calculator. Journal of Chemical Education 54: 114; February 1977.

The advantages of using a programmable calculator in computing student grades (e.g., in figuring weighted averages and in the linear adjustment of raw scores) are pointed out.

[Grade analysis, Programmable calculators]

Gaslin, William Lee. A Comparison of Achievement and Attitudes of Students Using Conventional or Calculator-Based Algorithms for Operations on Positive Rational Numbers in Ninth-Grade General Mathematics. Dissertation Abstracts International 33A: 2217; November 1972.

(See also: Journal for Research in Mathematics Education 6: 95-108; March 1975.)

Use of units in which fractional numbers were converted to decimals and examples then solved on a calculator was found to be a "viable alternative" to use of conventional textbooks (including fractions) with or without a calculator, for low-ability or low-achieving students.

[Algorithms, Desk calculators, General mathematics, Low achievers, Rational numbers, Research, Secondary (grade 9), Units]

Gawronski, Jane Donnelly and Coblenz, Dwight. Calculators and the Mathematics Curriculum. Arithmetic Teacher 23: 510-512; November 1976.

Use of the calculator is considered from a functional view and from a pedagogical view.

[Roles]

Gazdar, Abdus Sattar. A Short Program for Simpson's or Gazdar's Rule--Integration on Handheld Programmable Calculators. Two-Year College Mathematics Journal 9: 182-185; June 1978.

A flowchart and program for numerical integration are presented.

[College, Flow charts, Programmable calculators, Programming]

Geisinger, Kurt F. and Roberts, Dennis M. Individual Differences in Calculator Attitudes and Performance in a Statistics Course. (Presentation at AERA meeting, 1978.) ERIC: ED 156 457.

A 30-item instrument was developed to assess several dimensions of attitudes about calculators. Reliability and validity data were gathered on students in a college statistics course. Based on $N=135$, coefficient alpha was .874. Factor analyses identified three interpretable factors: trustworthiness of calculators, usefulness, and educational value. Correlations between attitude scores and both course grades and age were significant and positive. Females owned calculators more frequently than males, but there were no differences in attitudes based on sex or whether or not a student owned a calculator. Calculator ownership was positively related to age.

[Attitudes, College, Gender, Research (survey), Statistics]

Gibb, E. Glenadine. Calculators in the Classroom. Today's Education 64: 42-44; November-December 1975.

Ways in which the calculator can be used are discussed.

[Roles]

Gibb, Glenadine. My Child Wants a Calculator! NCTM Newsletter 12: 1; December 1975.

Some suggestions for selecting and using a calculator are given.

[Roles, Selection]

Giese, Madeline. What's Up with Those Calculators in the Classroom? Part 1. Calculators/Computers 2: 67-70; January 1978.

This report lists arguments and attitudes resisting and favoring the use of calculators in the classroom, curriculum comments from articles, and the author's reactions.

[Pros/cons, Roles]

Giese, Madeline. What's Up with Those Calculators in the Classroom?
Part 2. Calculators/Computers 2: 55-59; February 1978.

A summary of uses of calculators being encouraged and sources of information and materials are given.

[Pros/conc, References (selected), Roles]

Gilbert, Jack. Advanced Applications for Pocket Calculators. Blue Ridge Summit, Pennsylvania: Tab Books, 1975.

Mathematical and scientific problems and examples for all types of calculators are included.

[Activities]

Gilbreath, Catherine; Huber, James; and Myers, Alberta. Columbus Calculator Project (ESEA Title IV-C). Columbus, Ohio: Columbus Public Schools, 1978.

Modules for each of these topics are included: Know Your Calculator, Basic Facts, Place Value, Decimal Computation, Properties, Rounding, Estimation, and Applications.

[Activities, Curriculum, Four-function calculators, Worksheets]

Giordano, Al. Basic Business Machine Calculation: A Complete Course. Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1971.

[Business education, Course description, Desk calculators]

Girling, Michael. Towards a Definition of Basic Numeracy. Mathematics Teaching 81: 4-5; December 1977.

[Roles]

Girling, M. S. Basic Numeracy in the Electronic Age. Spectrum 16: 23-24; October 1978.

[Roles]

Gooden, Curtis Lee. Some Effects of Using Minicalculators in an Arithmetic Course on the Attitude Towards Mathematics and the Mathematics Achievement of Community College Students. (Kent State University, 1978.) Dissertation Abstracts International 39A: 2800-2801; November 1978.

Three groups (n = 220) in nine sections of College Arithmetic in a community college were involved in the study during spring 1977. The control group did not use calculators; one experimental group was allowed to use them "any time they wished"; the other experimental group was also assigned problems which required use of calculators approximately 85 percent of the time. Use of the calculator was found to be no more effective than paper-and-pencil techniques in increasing mathematical achievement and attitudes, but no loss in proficiency with paper-and-pencil skills was found when calculators were used.

[Achievement, Attitudes, College, Remedial, Research]

Goodhue, Joseph F. Calculator Crossword Puzzle. Mathematics Teacher 71: 279-282; April 1978.

Students are to use calculators to demonstrate their knowledge of the correct order of operations for a given mathematical expression in doing a worksheet and a crossword puzzle.

[Games, Mixed operations, Worksheets]

Goodrich, G. L.; Bennett, R. R.; and Wiley, J. K. Electronic Calculators for Visually Impaired Users--Evaluation. Journal for Visual Impairment 71: 154-157; April 1977.

Calculators appropriate for the visually impaired are described and evaluated.

[Handicapped (blind), Selection]

Goodson, Bobby. Let's Put the Calculators Where They Belong. Calculators/Computers 2: 20-22; November-December 1978.

Use of the calculator in work with square roots, geometry, factoring, and other junior high topics is discussed. A worksheet on finding a square root and a crossword puzzle developed by a student are given.

[Activities, Games, Junior high, Worksheets]

Goodson, Bobby. Calculator Resource Review. Calculators/Computers 2: 32-33; November-December 1978.

Some books of calculator activities which the author considers particularly useful for junior high classes are cited.

[Junior high, References (selected)]

Gottheimer, Debra. More Power to the Calculator. Administrative Management 39: 34-44; July 1978.

Programmable calculators, including hand-held as well as desktop models, are described. Two charts, one citing features for desktop calculators and one for programmable calculators, are included. Five industry trends are also noted.

[Desk calculators, Programmable calculators, Selection]

Goult, R. J. and Pratt, M. J. The Pocket Calculator Pocket Book. England: Stanley Thornes Ltd., 1977.

[Activities]

Graeber, Anna O.; Rim, Eui-Do; and Unks, Nancy J. A Survey of Classroom Practices in Mathematics: Reports of First, Third, Fifth and Seventh Grade Teachers in Delaware, New Jersey, and Pennsylvania. Philadelphia: Research for Better Schools, Inc., 1977.

In a survey in 1977 of 1,343 teachers in grades 1, 3, 5, and 7, questions on calculator use were included. The percentage of teachers who had used calculators was: 3.9 percent at grade 1, 8.4 percent at grade 3, 19.4 percent at grade 5, and 25.6 percent

at grade 7. In the first grade, calculators were used most frequently for drill; the next three most frequent usages were for checking, motivation, and remediation. Use of the calculator for drill decreased with grade level. Above first grade, the most frequent use was for checking, with motivation and word problems next most frequently reported used.

[Attitudes, Research (survey), Roles, Teachers (grades 1, 3, 5, 7)]

Greenfeder, Jack. Calculator Totals Two Sets of Numbers Simultaneously. Electronics 48: 108; July 24, 1975.

A method is explained for totalling two separate lists of numbers on a calculator having a combined memory entry and a summation key.

[Addition, Calculator memory, College]

Greenwood, Jay. A Product of Our Times. Mathematics Teacher 70: 234-238; March 1977.

Activities are described in which the calculator is used in a discovery learning situation for exploring number patterns in multiplication exercises.

[Pattern searches]

Gregory, John. Santa Takes a Calculated Risk. The Mathematics Student 22: 1-2; December 1974.

Two calculator number-word puzzles with a Christmas theme are presented.

[Activities]

Gregory, John W. Use the Calculator for Drill. Instructor 86: 104-105; April 1977.

Activities are described which feature the use of a calculator's constant key in drills on addition, subtraction, multiplication, and division facts.

[Drill, Elementary, Mixed operations (facts)]

Greynolds, Elbert B., Jr.; Aronofsky, Julius S.; and Frame, Robert J. Financial Analysis Using Hand-Held Calculators. New York: McGraw-Hill, 197 .

Covering the application of a wide range of hand-held calculators to financial analysis problems, this book stresses problem identification and analysis techniques in approaching the mathematics of finance.

[Consumer applications, Finance, Post-secondary]

Grinstein, Louise S. Calculators in the Classroom: A Selected Bibliography. MATYC Journal 12: 238-242; Fall 1978.

Thirty-two references are included in this annotated listing.

[References (selected)]

Grosswirth, Marvin. Calculators in the Classroom. Datamation 95: 90-91, 95; March 1975.

Pros and cons for the use of hand-held calculators in schools are given. Summaries of some experimental work using calculators in the classroom are presented, and the need for more research is stressed.

[Pros/cons, Research (review)]

Guthrie, Larry F. and Wiles, Clyde A. Why Not Have a Calculator Tournament? Arithmetic Teacher 23: 554-558; November 1976.

Steps in organizing a calculator tournament among schools are presented, with sample problems given.

[Activities]

Gwynne, Peter. New York View: Calculator Boom. New Scientist 65: 231-232; January 23, 1975.

The question of whether school children should be allowed to use calculators in the classroom is said to be at the root of a debate "raging" throughout the U.S. Proponents of calculators argue that their use for calculations can free time to explore the basic concepts of mathematics more deeply, while opponents insist that their use will lead to a generation of mathematical illiterates. As more students acquire calculators, pressure to allow their use on examinations is increasing. Several schools routinely use calculators, and children enjoy using them. Their use offers the opportunity to do more complex problems, but also provides the temptation to sell students arithmetic without understanding.

[Pros/cons]

Haberman, J. and Bernstein, S. Top-down Calculating. Datamation 21: 97-99; April 1975.

[Roles]

Haigh, Gordon. Calculator Worksheet Sequence and Sample Worksheets. Birmingham, England: 1978. Ditto copy.

These are samples of nearly 400 worksheets developed for children aged 9, 10, and 11 years. The author "rejected all elementary algorithms and looked for problems to turn up, then adjusted the syllabus accordingly."

[Elementary, Worksheets]

Haigh, Gordon. Electronic Learning Aids. Mathematics Teaching 86: 4-5; March 1979.

"The Little Professor" and "Dataman" are reviewed, with critical comments.

[Preprogrammed devices, Selection]

Hale, David S. Using Electronic Calculators. Mathematics Teaching 67: 20-21; June 1974.

Two examples of classroom use of the calculator are described, one with a fifth-year class computing the volumes of boxes which could be constructed from a piece of metal, and one with a third-year class testing hypotheses concerning volumes of similar solids.

[Elementary, Measurement]

Hallerberg, Arthur E. Squaring the Circle--For Fun and Profit. Mathematics Teacher 71: 247-255; April 1978.

Some historical approaches to finding the area of a circle are presented, with calculators particularly suggested for use in solving some of the problems.

[Geometry]

Hallden-Abberton, Patti and Waits, Bert K. The Programmable Calculator --An Inexpensive Teaching Machine. MATYC Journal 12: 215-219; Fall 1978.

A program is presented which enables a programmable calculator to become a device to check the arithmetic computational skills of students.

[Checking, College, Programmable calculators]

Hamada, Bob. Hand-held Calculators in the Classroom. The Calculator 18: December 1977. 18: January 1978. (Los Angeles City Teachers of Mathematics Education.

Suggestions for using calculators in the classroom are provided.

[Activities, Roles]

Hannon, Herbert. The \$59.95 Electronic Wonder: Its Implications for the Arithmetic Classroom. Mathematics in Michigan, pp. 3-6, November 1973.

Various implications of the use of calculators are discussed.

[Roles]

Hardcast, S. How to Select an Electronic Calculator. Electrical Review 194: 753; 1974.

Features to consider when selecting a calculator are noted.

[Selection]

Harkin, J. B. Computing Inverse Trigonometric Functions on a Hand-Held Calculator. (AMTNYS) New York State Math Teachers Journal 28: 91-95; Spring/Summer 1978.

Specific procedures for computing inverse trigonometric functions are presented, with concepts and structure noted. A calculus application and a computational application are included.

[Trigonometry]

Harrington, Ty. Those Hand-held Calculators Could Be a Blinking Useful Tool for Schools. American School Board Journal 163: 44, 46; April 1976.

Arguments for and against the use of calculators in the classroom are presented.

[Pros/cons]

Hartman, Arlene. The Calculator Game Book for Kids of All Ages. New York: New American Library, 1977.

Section I is devoted to number "tricks," organized into categories of addition, subtraction, multiplication, division, decimals, number tricks based on algebra, and enrichment topics. Explanations of why the tricks work are included. Section II gives rules for games and game-puzzles for one, two, or more players. In both sections, a grade span for which each activity is appropriate is indicated.

[Activities, Games]

Hartman, Elliott. Breaking Through the Googol Barrier. MATYC Journal 12: 208; Fall 1978.

An example is given for expressing y^x in scientific notation when the results exceed the calculator display.

[College, Notation]

Hatfield, Steven. Use of a Calculator with a Grade School Student. CATM Newsletter : 7-8; March 1978.

(See also: West Virginia Council of Teachers of Mathematics Newsletter : 18-19; Fall 1978.

Suggestions for using the calculator are provided.

[Elementary, Roles]

Hauser, Al W. Precalculated Fun. Phoenix, Arizona: Hauser Publications, 1978.

Puzzles that can be attacked with a calendar are included.

[Activities]

Hawthorne, Frank S. Hand-held Calculator: Help or Hindrance? Arithmetic Teacher 20: 671-672; December 1973.

Few curricular changes will be necessitated by the advent of the calculator. Elementary schools already emphasize an understanding of concepts and a meaningful approach to algorithms. It was partly anticipation of inexpensive calculators that impelled curriculum designers to decide that emphasis on drill was unwise. While calculators will produce no grand changes in the curriculum, calculators offer many advantages in the elementary school. Students can check their work, and laborious computation can be eliminated from problem solving activities. As with any teaching aid, they can be misused.

[Pros/cons, Roles]

Hawthorne, Frank S. and Sullivan, John J. Using Hand-held Calculators in Sixth-Grade Mathematics Lessons. New York State Mathematics Teachers' Journal 25: 29-31; January 1975.

This is a report on the study by Barrett and Keefe, involving two sixth-grade classes. A posttest at the end of the year indicated that the students using calculators scored higher on tests of concepts and computation than a non-calculator group, but not as high on problem-solving tests.

[Achievement, Elementary (grade 6), Four-function calculators, Research]

Hayman, H.J.G. Stereoscopic Diagrams Prepared by a Desk Calculator and Plotter. Journal of Chemical Education 54: 31-34; January 1977.

The use of a Hewlett-Packard 9810A programmable desk calculator with plotter for drawing ball-and-line stereopairs as well as three-dimensional structural formulas which are useful for teaching stereochemical principles and molecular structure is described.

[Chemistry, College, Desk calculators]

Hector, Judith Ellen. The Effects of Calculator Versus Conventional Algorithms for Fractions on Community College Student Computation, Understanding, and Attitude Scores. (The University of Tennessee, 1978.) Dissertation Abstracts International 39A: 6605; May 1979.

Students in developmental arithmetic courses at two community colleges (N = 48, 33) were randomly assigned to three treatment groups: use of conventional algorithm, conventional algorithm plus calculators, or alternative algorithm involving conversion from fractions to decimals with calculators. Self-paced slide-tape-workbook presentations were used. No significant differences among groups was found for fractional computation or understanding, or attitude toward mathematics, but significant differences between pre- and posttest scores were found for each measure.

[Achievement, Attitudes, College, Fractions, Research]

Heilman, Carl. More References to Calculators. Pennsylvania Council of Teachers of Mathematics Newsletter 13: 12-14; Spring 1975.

Articles concerning electronic calculators are listed with brief descriptions, to call them to the attention of mathematics teachers in Pennsylvania.

[References (selected)]

Hemer, O. Erfarenheter Av Användning Av Räknedosa I Gymnasieskolan. Report No. 26/77. Malmö, Sweden: Lararhögskolan, 1977.

This report, written in Swedish, addresses questions about calculator use. Replies include specific illustrations of mathematical topics with which calculators are used with students aged 16-19 (grades 10-12).

[Activities, Research, Roles, Secondary (grades 10-12)]

Henrici, Peter. Computation Analysis with the HP-25 Pocket Calculator. New York: John Wiley & Sons, 1977.

This book contains 30 high-level mathematical programs written for the HP-25 programmable calculator. The programs implement algorithms in number theory, equation solving, algebraic stability theory, calculus of power series, and numerical integration as well as algorithms for the evaluation of special higher transcendental functions such as the Gamma function; various Bessel functions, the error integral, and the Riemann zeta function. By means of the flow diagrams and the detailed descriptions provided, the programs are adaptable for any calculator of comparable capacity.

[College, Programmable calculators]

Henry, Douglas R. Simple Method for Producing Giant Scoreboard-Like Digital Displays. Journal of Chemical Education 55: 242; April 1978.

A device for converting LED digital displays to large-scale displays is described.

[Building, Chemistry, College]

Henry, Loren L. An Invaluable Aid to Understanding Mathematics: The Hand-Held Calculator. School Science and Mathematics 77: 585-591; November 1977.

Instructional techniques are given for the use of calculators in finding prime numbers, solving trigonometric equations, and solving polynomial equations.

[Activities, Secondary]

Herget, W.; Hischer, H.; and Sperner, P. Taschenrechner und Rechenstab im Mathematikunterricht. Praxis der Mathematik 20: No. 7, 1978.

[Roles]

Herron, J. Dudley. High School Forum. Journal of Chemical Education 54: 628; October 1977.

The uses of programmable calculators in secondary school classrooms are discussed, including grading, laboratory, exercises, computing T-scores, and a quantitative approach to chemical equilibrium.

[Chemistry, Programmable calculators, Roles, Secondary]

Hewlett-Packard. Enter vs. =. Cupertino, California: Hewlett-Packard Co., 1974.

[Calculator logic]

Hewlett-Packard. The Programming Book. Knoxville, Tennessee: Approach 13-3-Corporation, 1976.

This booklet covers steps in writing and using effective programs, special programming features (starting and stopping a program,

editing, transferring capabilities, subroutines, and indirect control), and consumer information on selecting a programmable calculator.

[Programmable calculators, Programming, Selection]

Hewlett-Packard. What to Look For Before You Buy an Advanced Calculator. Corvallis, Oregon: Hewlett-Packard, 1976.

General types of advanced calculators, calculator logic, special features and functions, programmable calculators, and calculator construction are topics discussed in this booklet.

[Selection]

Hewlett-Packard. Games Pac I. Palo Alto, California: Hewlett-Packard, 1977.

There is a collection of games for the HP-67 and HP-97 programmable calculators. There are 19 programs, prerecorded on magnetic cards, varied in difficulty, and can be played by two or by more people.

[Games, Programmable calculators]

Hiatt, Art. A Geometry Problem for Hand-Held Calculators or Computers. Calculators/Computers 1: 37-38; May 1977.

A mathematical inquiry method (making and organizing observations, generalizing, specializing, inventing symbolism, and proving conjectures) and the calculator's role as an important tool for this process are discussed. An example is given in which the concept of area of a circle can be investigated with the calculator, and a worksheet for students is provided.

[Geometry, Roles, Secondary, Worksheets]

Hiatt, Arthur A. Finding Areas Under Curves with Hand-Held Calculators. Mathematics Teacher 71: 420-423; May 1978.

The method of inquiry is applied to find the area of a circle using the calculator.

[Geometry]

Hiatt, Arthur A. Basic Skills: What Are They? Mathematics Teacher 72: 141-144; February 1979.

With the calculator, students' mathematical thinking should be improved as they handle non-routine problems in which a number of accurate calculations are necessary. Specific examples involving use of the calculator in applying process skills are given.

[Activities, Problem solving]

Hickey, Albert E. The Use of the Computer in Mathematics Education. Two Year College Mathematics Journal 1: 44-54; Spring 1970.

Considered is the pedagogical question of what can be done with the computer that is relevant to the mathematics curriculum. Five

different modes of interaction between the computer and the students are proposed: problem solving, programmed desk calculators, simulation, drill and practice, and tutorial.

[College, Desk calculators, Roles]

Higgins, Jon. News on Calculators: A Reprint of Calculator Information Center Information Bulletin No. 3. Colorado Mathematics Teacher 11: 5; September 1978.

[Selection]

Higgins, Jon L. Mathematics Programs Are Changing. Education Digest 40: 56-58; December 1974. (Reprint from NASSP Curriculum Report.)

Inexpensive pocket calculators will change both the kinds of computational skills taught and the manner in which they are taught. Knowing when operations are used, checking errors, and estimation will become the new fundamental skills. Programmable calculators will soon become commonplace, and emphasis will be placed on the unity of mathematics and the common procedures of mathematical thought.

[Roles]

Hill, Shirley. Issues from the NACOME Report. Mathematics Teacher 69: 440-446; October 1976.

Among the issues discussed is the NACOME recommendation on calculators. Several questions are raised concerning the implications for the mathematics curriculum.

[Recommendations, Roles]

Hobbs, Billy F. and Burris, Charles H. Minicalculators and Repeating Decimals. Arithmetic Teacher 25: 18-20; April 1978.

An algorithm for generating on any calculator as many digits as desired in the decimal representation of the rational number N/D is given in detail.

[Algorithms, Rational numbers]

Hoffmann, Ronit. Teaching Mathematics from an Algorithmic Point of View with the Use of Pocket Calculator. Unpublished M.A. thesis, Tel Aviv University, July 1977.

A unit for teaching algorithms and the use of the programmable pocket calculator SR-56 was developed, planned for students in the Teachers' Training College who will teach science or mathematics in Comprehensive Schools. It can be used also in High Schools in Grades 10 and may even be used in higher classes of the Comprehensive Schools. The unit was evaluated with teachers of natural science, using measures of achievement and attitudes.

[Programmable calculators, Research (evaluative), Secondary (grade 10), Teachers (preservice), Units]

Hoffman, Ruth I. Don't Knock the Small Calculator--Use It! Instructor 85: 149-150; August/September 1975.

Several examples of using calculators to explore mathematical ideas are presented.

[Roles]

Hohlfeld, Joseph Francis. Effectiveness of an Immediate Feedback Device for Learning Basic Multiplication Facts. (Indiana University, 1973.) Dissertation Abstracts International 34A: 4563; February 1974.

The effectiveness of an electronic calculator, programmed as an immediate feedback device, was compared with the effectiveness of pencil-and-paper exercises without immediate feedback for the learning of the 100 basic multiplication combinations. Twelve students in each of seven fifth-grade classes were identified as low achievers and randomly assigned to treatment. Significant differences favored the electronic calculator practice group over the pencil-and-paper practice group on both acquisition and short-term retention, but not on long-term retention (one month or three-and-one-half months' retention periods).

[Desk calculators, Drill, Elementary (grade 5), Multiplication (facts), Research]

Holdsworth, David. Applications of Programmable Calculators in Chemistry. Australian Science Teachers Journal 23: 74-76; May 1977.

Described is the use of calculators in two experiments. In the first, students determine the relative atomic mass of magnesium. In the second, students use a calculator to determine a constant for gaseous concentrations of two reactants and the product at equilibrium.

[Chemistry, College, Programmable calculators]

Holdsworth, David. An Investigation into the Uses of Calculators in School Chemistry Courses. Australian Science Teachers Journal 23: 113-116; November 1977.

[Chemistry, Secondary]

Holmes, Dick. Kids 'n Calculators. Alberta Teachers Association Mathematics Council 18: 11-21; November 1978.

[Roles]

Hopkins, Billy Lynn. The Effect of a Hand-Held Calculator Curriculum in Selected Fundamentals of Mathematics Classes. (The University of Texas at Austin, 1978.) ERIC: ED 156 496.

This study investigated the effects on achievement and attitude resulting from use of a calculator-based curriculum and calculators in ninth-grade basic mathematics (in which students were at least two grade levels behind in mathematics achievement). Twelve

classes from three schools were randomly assigned to either calculator ($n = 83$) or non-calculator groups ($n = 84$). For four weeks, teachers used guides prepared by the investigator to teach estimation, computation, and problem solving using the four operations with whole numbers. One-half of each group was randomly selected to take the posttest with calculators available, while the other half did not have calculators. Data were analyzed by analysis of covariance. Students using calculators in instruction scored as well in computation and significantly better in problem solving as their peers not using calculators. Attitudes were not significantly different. Students using calculators on the posttest did significantly better in both computation and problem solving than students not using calculators.

[Achievement, Attitudes, Basic mathematics, Estimation, Mixed operations, Problem solving, Research, Secondary (grade 9), Units]

Hopkins, Edwin E. A Modest Proposal Concerning the Use of Hand Calculators in Schools. Arithmetic Teacher 23: 657-659; December 1976.

(See also: Hopkins, Edwin E. Using Hand Calculators in Schools. Education Digest 42: 44-45; February 1977.

A proposal that the fullest possible use of calculators be made at all grade levels is discussed.

[Roles]

Huff, D. Teach Your Pocket Calculator New Tricks to Make Life Simpler. Popular Science 205: 96-98; December 1974.

Interesting things to do with a hand-held calculator are presented.

[Activities]

Huff, Darrell. How to Have Fun with Your Pocket Calculator. Popular Science 208: 90-91, 152; February 1976.

Activities and games for the calculator are presented.

[Activities]

Huff, Darrell. Calcu-Letter. Popular Science

211: 23-24; November 1977.

212: 8; January 1978.

212: 6; March 1978.

212: 40; May 1978.

213: 22; July 1978.

213: 56-57; September 1978.

213: 62-63; November 1978.

214: 58; January 1979.

214: 23; March 1979.

The bi-monthly column presents some problems (with answers appearing in later columns), some hints on how to use a calculator, and some comments on particular calculators.

[Activities]

Huffman, Harry. Percent of Agreement/Disagreement by 188 High School and College Business Teachers About Issues in Business Mathematics and Recordkeeping (April 1977 Survey). Huffman Business Education Newsletter 2: 2; November-December 1977.

52 percent of the high school teachers and 78 percent of the college teachers agreed that students should be permitted and encouraged to bring calculators to class; 26 percent and 5 percent disagreed, with the remainder neutral. 70 percent of the high school teachers and 81 percent of the college teachers agreed that calculator instruction should be integrated into the business math course, with 9 percent and 4 percent disagreeing. Only 3 percent and 2 percent agreed, however, that emphasis on and review of arithmetic skills are no longer needed because of the prevalence of calculators, with 96 percent and 70 percent disagreeing.

[Attitudes, Business education, College, Research (survey), Secondary, Teachers]

Huffman, Harry and Welter, Clyde W. Updating Business Education Programs. Business Education Forum 30: 5-13; January 1976.

Among new technological developments affecting business education courses is the calculator. A course in business applications of the calculator at one university is noted.

[Business education]

Hughes, B. G. and Bundschuh, J. E. The Use of a Hand-Held Programmable Calculator in Evaluating Freshman Experiments. Journal of Chemical Education 55: 336-337; May 1978.

The use of a programmable calculator for evaluating a student's performance on a quantitative laboratory experiment is presented.

[Chemistry, College, Programmable calculators]

Humphreys, Casey, et al. Calculator Cookery. Minneapolis: Minneapolis Public Schools, East Area Curriculum Office, 1977. ERIC: ED 146 009.

Worksheets were designed for use with low-achieving ninth and tenth graders; they are also appropriate for seventh and eighth graders. Activities are included on: introduction to the calculator, games, exploring algorithms, pattern search, estimation and reinforcement of basic computations, consumer applications, and societal applications. Notes for teachers are included with each of the lessons.

[Activities, Low achievers, Secondary (grades 7-10), Worksheets]

Hunter, William L. Getting the Most Out of Your Electronic Calculator. Blue Ridge Summit, Pennsylvania: Tab Books, 1974.

This book describes some basic problems that the layperson can solve using a pocket calculator. Working with basic mathematics, grocery shopping, computing simple interest, and tax preparation are some of the topics included.

[Consumer applications]

Hutton, Lucreda Ann Williams. The Effects of the Use of Mini-Calculators on Attitude and Achievement in Mathematics. (Indiana University, 1976.) Dissertation Abstracts International 37A: 4934; February 1977.

A 4-week unit on powers, roots, and radicals was studied by one group of ninth-grade algebra students who had traditional instruction with no calculators, a second group who had traditional instruction but could use calculators during class, and a third group who had special calculator instruction plus access to calculators during class. No differences were found when groups were compared on achievement or attitude.

[Achievement, Algebra, Attitudes, Powers, Research, Roots, Secondary (grade 9), Units]

Hutton, Lucreda A. An Experimental Study of the Effects of Mini-Calculators on Mathematics Achievement and Attitude in Grades Four, Five, and Six. July 1978. Xerox copy.

This study investigated the effects of the use of calculators, coupled with additional curriculum support materials, on mathematics achievement and attitudes of approximately 2000 pupils in grades 4, 5, and 6 in 12 inner-city Title I schools. A textbook supplement, a weekly problem-solving lesson, and calculator games and activities were prepared. A highly significant (.01) increase in problem-solving achievement by sixth-grade students was found, with no significant difference in computation performance. A significant (.01) decrease in computation performance by fourth-grade students was recorded, with no significant difference in problem-solving performance. However, when the students were permitted to use the calculators on the computation test, they scored well above grade level. No significant difference in attitudes was found, although teachers felt there was an improvement.

[Achievement, Attitudes, Elementary (grades 4-6), Research, Units]

Hutton, Lucreda A. Calculator Calisthenics. Arithmetic Teacher 26: 37; November 1978.

(See also: MCATA Newsletter 17: 37-38; February 1978.)

This activity is designed to improve retention of multiplication facts in a game format.

[Games, Multiplication (facts)]

Hyatt, H. R. and Feldman, Bernard. The Hand-Held Calculator--Uses and Applications. New York: John Wiley & Sons, Inc., 1979.

How to use calculators is described, with examples.

[Activities, College, Four-function calculators, Scientific calculators]

Hyatt, Herman R.; Drooyan, Irving; and Carico, Charles C. Arithmetic with Pushbutton Accuracy. New York: John Wiley & Sons, 1977.

The book presents arithmetic using a hand-held calculator, with an emphasis on problem solving. Consumer-oriented problems, including comparison shopping, interest, and depreciation, are given.

[College, Consumer applications]

Hyatt, H. R.; Drooyan, I.; and Carico, Charles. Introduction to Technical Mathematics: A Calculator Approach. New York: John Wiley & Sons, 1979.

The use of calculators is integrated with the mathematical presentation in this text for technical mathematics.

[College, Technical mathematics]

Immerzeel, George. It's 1986 and Every Student Has a Calculator. Instructor 85: 46-51, 148; April 1976.

Topics discussed include calculator algorithms, calculator problems, homework, problem-solving skills, mental arithmetic skills, and designing tests for use with calculators. Specific problems for primary, middle, and upper elementary grades are also included.

[Roles]

Immerzeel, George. The Hand-held Calculator, Arithmetic Teacher 23: 230-231; April 1976.

The author argues that hand-held calculators are increasingly available to all students and that mathematics educators should immediately begin exploring methods of using calculators to improve mathematics instruction.

[Roles]

Immerzeel, George. It's In Your Hands. Arithmetic Teacher 23: 493; November 1976.

Teachers are reminded of their responsibility for deciding how best to use the calculator in their classrooms.

[Roles]

Immerzeel, George. Ideas and Activities for Using Calculators in the Classroom. Dansville, New York: The Instructor Publications, Inc., 1976.

[Activities]

Immerzeel, George. 77 Ideas for Using the Rockwell 18R in the Classroom. Anaheim, California: Rockwell International, 1976.

Aimed at the intermediate and junior high levels, these calculator ideas deal with topics such as basic computation, numeration, measurement, and problem solving. The calculator is used to facilitate the development of the concept and not just as a substitute for needed computational skills.

[Activities, Elementary (grades 4-6), Junior high]

Immerzeel, George and Ockenga, Earl. Calculator Activities for the Classroom, Books 1 and 2. Palo Alto, California: Creative Publications, 1977.

Book 1 contains activities, drills, and games for students in grades 4-6, while Book 2 focuses on the mathematics of algorithms and formulas and on consumer mathematics for students in grades 7-9.

[Activities, Elementary (grades 4-6), Junior high]

Iowa. Getting to Know the Calculator Mathematical Problem Solving Project, University of Northern Iowa, 1975. ERIC: ED 161 757.

Worksheets are provided to help the child learn how to use the calculator.

[Activities, Elementary, Problem solving, Worksheets]

Iowa. Calculator Handbook. Mathematical Problem Solving Project, University of Northern Iowa, 1975. ERIC: ED 161 758.

These student worksheets include activities in counting, place value, estimation, the four operations with whole numbers, number patterns, perimeter, inequalities, decimals, decimal equivalents of fractions, and percents, all to be worked with a calculator.

[Activities, Elementary, Problem solving, Worksheets]

Iowa. Problem Solving: Opening the Door Using the Mini-Calculator. Mathematical Problem Solving Project, University of Northern Iowa, 1975. ERIC: ED 161 759.

This booklet outlines five different ways in which calculators can be used to develop a student's ability to solve problems: for solving problems which use real-world data, for solving a greater number of standard word problems, for using different approaches to solve problems, for extending problem situations, and for using the calculator in an experimental setting. Each section presents problems which exemplify these five uses of the calculator.

[Activities, Elementary, Problem solving, Worksheets]

Iowa Problem-Solving Project (ESEA Title IV-C). (Joan Duea, George Immerzeel, Earl Ockenga, John Tarr, and Jack Wilkinson. Cedar Falls: University of Northern Iowa, 1978.

The purpose of this project is to develop materials to improve the mathematical problem-solving abilities (using calculators) of students in grades 5-8. The materials are available in classroom sets for experimentation: 1 teacher's edition with teacher's notes, record sheets, answers, and tests; 15 pupil copies of skill booklets (approximately 30 pages); and 100-card problem deck. Modules include: Problem Solving . . . Using the Calculator, Using Tables, Using Guesses, Using Resources, Using the Calculator (Book II), Using Calculator Codes (Books I and II).

[Elementary (grades 5-6), Junior high (grades 7-8), Problem solving, Units]

Indiana. Minicalculators in Mathematics Classes. In Mathematics Guidelines. Bloomington: Indiana Department of Public Instruction, 1977.

Mathematics teachers and curriculum planners are encouraged to incorporate calculators into the regular classwork at all levels from primary grades to calculus. Calculators can be used to improve computational skills, to reinforce concepts, and to provide more time for realistic problem solving. Nine uses of calculators in the classroom are suggested.

[Recommendations, Roles]

Irvin, Barbara B. (editor). Data Tasks for Exploring Math with DataMan. Dallas: Texas Instruments Learning Center, 1978.

[Activities, Drill, Preprogrammed devices]

Jacobs, Russell F. Problem Solving with the Calculator. Phoenix: Jacobs Publishing Co., Inc. 1977.

This booklet includes calculator exercises for whole numbers, decimals and fractions, percent, and supplementary activities (magic squares, number tricks, polygonal numbers, square root, and repeating decimals).

[Activities, Elementary (grade 6), Junior high, Problem solving]

Jamele, P. R. How to Select and Use a Calculator--or Getting the Most from Your 4-Function Calculator. Los Angeles: Crescent Publications, 1975.

Special features of different calculators are explained. Instructions for solving some special problems with a four-function calculator are given; algebraic equations, exponents, higher roots, geometric problems, annuities, linear interpolation, series evaluation, and use of the calculator when answers exceed the eight-digit capacity are covered.

[Activities, Four-function calculators, Selection]

Jamski, William Donald. The Effect of Hand Calculator Use on the Achievement of Seventh Graders Learning Rational Number-Decimal-Percent Conversion Algorithms. (Indiana University, 1976) Dissertation Abstracts International 37A: 4934-4935; February 1977.

(See also: Jamski, William D. The Effect of Calculators on Achievement. MATYC Journal 13: 52-56; Winter 1979.)

Three classes of students at the seventh-grade level used calculators during a four-week unit on finding equivalent forms for fractions, decimals, and percents, while three other classes did not use calculators. On an immediate posttest a significant difference was identified between groups on items involving conversion from a simplified fraction to a decimal. No differences were found between groups when a retention test was given.

[Achievement, Junior high (grade 7), Rational numbers, Research]

Jamski, William D. Earth and the Calendar. School Science and Mathematics 78: 517; October 1978.

The calculator can be used to compile a table comparing calendar years with planetary years.

[Activities, Science]

Jamski, William D. Compound Interest a la Simple Calculator. Mathematics Teacher 72: 359-362; May 1979.

Worksheets provide explorations of the relationship between simple and compound interest.

[Activities, Consumer applications, Worksheets]

Janota, C. P. Powerful Calculators for Blind. Electronic Design 25: 54; No. 5, 1977.

[Handicapped (blind), Selection]

Jansson, Lars. Make the Most of Your Pocket Calculator, England: Foulsham, 1978.

[Activities, Secondary]

Jefimenko, Oleg. How to Entertain with Your Pocket Calculator, Star City, West Virginia: Electret Scientific Co., 1975. Also Ormond Beach, Florida: Camelot Publishing Co., 1975.

Mathematical diversions are presented.

[Activities]

Jennings, B. A. and Towns, P. G. Calculators as a Teaching Aid. New Zealand Mathematics Magazine 15: 5-7; May 1978.

The use of calculators in a high school mathematics program is briefly described.

[Roles, Secondary]

Jesson, David and Kurley, Frank. Specifications for Electronic Calculators. Mathematics Teaching 70: 42-43; March 1975. Reprinted in Mathematics Teacher 69: 80-82; January 1976.

Features, listed in order of preference, are discussed: natural-order arithmetic, floating point, underflow, constant key to operate on all four operations, eight-digit display, fingertip-size keys, rechargeable batteries with alternative plug-in operation, and clear-entry key.

[Selection]

Jewell, Wallace F., Jr. Hand Calculators in Secondary Education: Evaluation, Analysis and Direction. Unpublished doctoral dissertation, State University of New York at Buffalo, 1979.)

The purpose of this study was to analyze and evaluate present hand-held calculator uses and materials and propose possible directions

for their utilization in the near future. Also included is an analysis of the usual high school mathematics curriculum of elementary algebra, geometry, intermediate algebra-trigonometry, and elementary functions with regard to calculator implementation.

[Curriculum, Research (review), Secondary]

Jewell, Wallace F., Jr. Teaching Remedial Mathematics with Calculators. MATYC Journal 13: 41-46; Winter 1979.

A basic mathematics review course using the hand calculator as a complete substitute for paper-and-pencil calculation is described.

[College, Course description, Remedial]

Jewell, Wallace F., Jr. Can the Calculator Be Wrong? Spring 1979.

Xerox copy.

[Activities]

Johnson, David C. Calculators: Abuses and Uses. Mathematics Teaching 85: 50-56; December 1978.

Four common abuses of the calculator are noted: calculations for no apparent purpose other than to use the calculator; games and puzzles with no apparent mathematical objective; mystical button pushing; and checking answers. A variety of examples in which the calculator can be used effectively are extensively discussed.

[Activities, Pros/cons, Roles]

Johnson, Randall Erland. The Effect of Activity Oriented Lessons on the Achievement and Attitudes of Seventh Grade Students in Mathematics. (University of Minnesota, 1970.) Dissertation Abstracts International 32A: 305; July 1971.

Activity-oriented instruction, including one treatment in which calculators were used, did not appear to be more effective than instruction with little or no emphasis on activities, for units in number theory, geometry and measurement, and rational numbers.

[Achievement, Activities, Desk calculators, Junior high (grade 7), Research, Units]

Johnsonbaugh, Richard. Applications of Calculators and Computers to Limits. Mathematics Teacher 69: 60-65; January 1976.

(See also: Reader Reactions, Mathematics Teacher 69: 436-438; October 1976, for comments and further examples.)

Computing numbers approaching a limit is discussed, with a convergence theorem and several examples.

[Calculus]

Johnston, Carol Lee. Slide Rule with Calculator References: A Textbook for Classroom and Self-Instruction. Dubuque, Iowa: W. C. Brown Co., 1976.

[Slide rule]

Johnston, David W. Reactions (to The Tin Can Problem). Calculators/Computers 2: 45-47; February 1978.

A programmable calculator program to solve the equations in the Tin Can Problem (Clyde, 1978) is presented in this letter.

[Problem solving, Programmable calculators, Programming]

Johnston, David W. Letters. Calculators/Computers 2: 82-83; April 1978.

Three programs for exercises in Scott (1978) are given in this letter.

[Programmable calculators, Programming, Roots]

Johnston, David W. Letters. Calculators/Computers 2: 12-13; September/October 1978.

A calculator program to solve for mean, standard deviation, and "normal curve" equation is given, to supplement Crothamel (1978).

[Programmable calculators, Programming, Statistics]

Jones, C. D. Pocket Math. National Elementary Principal 53: 56-57; January 1974.

Three children (aged 6, 7, and 10), who used a pocket calculator for one-and-one-half weeks, learned to use the machine in self-initiated activity. However, it took a while for them to trust it.

[Elementary]

Jones, Edris Whitted. The Effect of the Hand-Held Calculator on Mathematics Achievement, Attitude and Self Concept of Sixth Grade Students. (Virginia Polytechnic Institute and State University, 1976.) Dissertation Abstracts International 37A: 1387; September 1976.

One hundred thirteen sixth-grade students used calculators for about an hour daily for 9 weeks, while another group of 58 sixth graders used paper and pencil only. Results showed that students using calculators made significant gains ($p < .001$) in total achievement, computation, and concept scores; no differences were found in attitude or self-concept. Girls in the experimental group scored significantly higher on concepts than did boys.

[Achievement, Attitudes, Elementary (grade 6), Gender, Research]

Joneson, O. A. Calculator Ideas. Mankato, Minnesota: Mankato State University, 1978. Xerox copy.

This is a collection of activities, articles, and references prepared for use in the author's classes.

[Activities, References]

Jordan, James H. An Elementary Construction of the Common Log Tables. Two-Year College Mathematics Journal 8: 274-278; November 1977.

[College, Logarithms]

Judd, Wallace. Games, Tricks, and Puzzles for a Hand Calculator. Menlo Park, California: Dymax, 1974.

This book is a source of recreational ideas for use with the calculator, with sections on each of the topics of the title. Included also is a section on the internal workings of a calculator.

[Activities, Games]

Judd, Wallace. Rx for Classroom Math Glahs: A New Case for the Calculator. Learning 3: 41-48; March 1975.

As calculators are increasingly used, drill will be de-emphasized in favor of problem-solving activities. Considerations for selecting calculators and selected games for use with calculators are described.

[Games, Problem solving, Roles, Selection]

Judd, Wallace. Games Calculators Play. New York: Warner Books, 1975.

Along with a collection of games, riddles, number patterns and tricks, there is advice on how to use a constant, figure percentages, and expand the calculator's functions. A brief section is included on the inner construction of a calculator.

[Activities, Games]

Judd, Wallace. Instructional Games with Calculators. Arithmetic Teacher 23: 516-518; November 1976.

Seven games are presented, with the mathematical concepts involved, the objective, the number of players needed, the rules, and variations for different grade levels listed for each.

[Games]

Judd, W. Dogfight and More Games Calculators Play. New York: Warner Books, 1977.

Games and other activities with calculators are provided.

[Games]

Judd, Wallace. Problem Solving Kit for Use with a Calculator. Chicago: Science Research Associates, 1977.

This classroom kit includes 12 problem-solving sections, each of which stresses a different problem-solving technique or area. In addition to the student workcards and record folders, the kit contains spirit masters for evaluating student achievement and a teacher's guide.

[Kit, Problem solving]

Jurgensen, Marlinde. Measuring Triangles. Calculators/Computers 2: 50-52; November-December 1978.

A teaching plan using calculators with the Pythagorean Theorem is presented, with a worksheet on measuring triangles.

[Geometry, Worksheets]

Kahn, Henry F. The Calculator a Calendar? Arithmetic Teacher 23: 651-653; December 1976.

A method for using the calculator to determine the day of the week on which any given date falls is explained.

[Activities, Time]

Karp, Stewart. Calculators for the Chemist. Journal of Chemical Education 52A: 346-350; July 1975.

This is the first part of a two-part article surveying calculators of interest to the chemist. The range of electronic calculators currently available and their capabilities are surveyed.

[Chemistry, Selection]

Karp, Stewart. Calculators for the Chemist. Journal of Chemical Education 52A: 373-379; August 1975.

This is the second part of a two-part article surveying calculators of interest to the chemist. Desk top calculators now on the market are described, including manufacturers, prices, and functions performed. A table of specifications for programmable desk calculators is provided.

[Chemistry, Desk calculators, Selection]

Kasnic, Michael James. The Effect of Using Hand-held Calculators on Mathematical Problem-Solving Ability Among Sixth Grade Students. (Oklahoma State University, 1977.) Dissertation Abstracts International 38A: 5311; March 1978.

Sixth-grade students from four randomly selected schools in a suburban school district were assessed on problem-solving ability and placed in a low, average, or high ability group. Ten students were randomly selected from each group at each school; schools were randomly assigned to one of four treatments: using calculators to practice problem solving; using calculators to practice problems and on the posttest of problem solving; practice on problems with paper and pencil only; or a control group. Nine 50-minute sessions of practicing problem solving comprised the treatment period. The calculator groups did not complete significantly greater numbers of practice problems than the non-calculator group, nor did groups differ on the number of correct responses. No significant differences were found between low and high ability groups.

[Elementary (grade 6), Problem solving, Research]

Kastner, Sheldon B. Remedial Mathematics Skills Program for Optional Assignment Pupils; School Year 1974-75. Brooklyn: New York City Board of Education, Office of Educational Evaluation, 1975. ERIC: ED 137 477.

This report of an evaluation of a New York City educational project. The major objective was to increase the computational skills of students in grades 9 through 11. Calculators, printing calculators, and programmable calculators were available for student use. On the average, program participants made one year gain in actual achievement beyond that which was predicted from a regression analysis on their previous history of achievement.

[Remedial, Research (evaluation), Secondary (grades 9-11)]

Kaufman, Burt A. and Haag, Vincent H. New Math or Old Math? -- The Wrong Question. Arithmetic Teacher 24: 287-292; April 1977.

Four examples are given to show how children can be involved in intellectual experiences in mathematics. The fourth example describes an activity which uses number properties to extend the range of a calculator beyond its eight-digit display capabilities.

[Activities, Properties, Roles]

Keller, Clifton. Using Tables to Teach Mathematics. Mathematics Teacher 71: 655-656; November 1978.

Use of calculators is suggested as an aid in performing the calculations involved in pattern searches.

[Integers (reciprocals), Pattern searches, Secondary]

Kelley, J. L. and Lansing, Ira. Interim Report on Project EQUIP. Berkeley, California, July 1975.

This document reports on Berkeley's mini-calculator program for teaching mathematics to low achievers in junior high school classes. Data on four experimental and four control classes are presented.

[Junior high (grades 7-8), Low achievers, Research]

Kenner, Hugh. Goedesic Math and How to Use It. Berkeley: University of California Press, 1976.

This is a comprehensive guide to calculations for domes; included are some HP-65 calculator programs.

[College, Engineering, Programmable calculators, Programming]

Keough, John J. and Burke, Gerald W. Utilizing an Electronic Calculator to Facilitate Instruction in Mathematics in the 11th and 12th Grades. Final Report. July 1969. ERIC: ED 037 345.

The group using calculators achieved significantly more on a standardized test than did a group not using them.

[Achievement, Desk calculators, Research, Secondary (grades 11-12)]

Kerr, Steven D. Who is Quickest with Mind and Fingers? Mathematics Teacher 72: 123-126; February 1979.

A "thinking person's calculator race" is described, with sample questions.

[Activities]

Kessner, Arthur. Exploring Calculators in Primary Mathematics. Berkeley, California: Regents of the University of California, 1975.

A report on a study with primary grade children is presented.

[Elementary (grades k-1), Research]

Kessner, Arthur and Slesnick, Twila. Myths about Calculators in the Schools. Calculators/Computers 2: 78-81; September/October 1978.

Six concerns or fears about the use of calculators are discussed. Fear of dependence on calculators, the age at which calculators should be introduced, the roles of decimals and fractions, and the relationship of standard algorithms are included.

[Pros/cons]

Kibler, Tom R. and Campbell, Patricia B. Reasing, Writing and Computing: Skills of the Future. Educational Technology 16: 44-46; September 1976.

The calculator's role in helping students solve more complex and relevant problems is stressed.

[Problem solving, Roles]

Kilmer, Jean E. Periodic Decimal Discoveries with a Calculator. Journal of California Math Council 3: 23-27; October 1978.

Techniques, discoveries, and exercises for computing with periodic decimals are given.

[Decimals]

King, Ronald Scott. Presentation of Hierarchical Clustering Techniques in the Two Year College Mathematics Classroom. MATYC Journal 12: 97-101; 1978.

A grouping procedure which systematically combines objects to satisfy a criterion specified by the investigator and groups those objects that are most alike first is discussed. Two such methods that can be easily demonstrated in the classroom with calculators are presented.

[College, Statistics]

Kinzey, Vera G. Office Machines Equipment Selection. Journal of Business Education 50: 145-147; January 1975.

[Business, Selection]

Kinzey, Vera G. Mastering Ten-Key Calculators: Electronic and Mechanical. New York: Harcourt Brace Jovanovich, Inc., 1976.

[Business, Desk calculators]

Kissane, Barry V. Intuitive Statistical Inferences. Australian Mathematics Teacher 34: 183, 189; December 1978.

The calculator can be used as an aid in ascertaining statistical inferences.

[Activities, Statistics]

Kissler, Gary D.; Dreese, Curtis W.; and Kissler, Janice M. The Effects of Student Calculator Use upon Measures of Numerical Aptitude and Business Statistics. February 1978. ERIC: ED 160 447.

In the first study, 127 college sophomores in a business course were randomly assigned to one of four groups and given a 40-item aptitude scale, with an 8-week interval before a second testing. Students using calculators performed consistently better and sometimes significantly better than students not using calculators. In the second study, 266 college sophomores in a business statistics course were tested as they used or did not use calculators. In every instance in which calculators were used, the group using them received a higher score; however, significant differences were found on only three of five exams on which more recall of computational procedures was needed.

[Business, College, Research, Statistics]

Kitchen, William. Utilization of Electronic Calculators in Engineering, Science, and Mathematics Programs. MATYC Journal 5: 9; Fall 1971.

Using calculators in college courses is discussed.

[College, Engineering, Roles, Science]

Klīmas, Florence E. Using a Hand-Held Calculator for Problem Solving in Sixth Grade. Master's thesis, Ken College of New Jersey, April 1979.

Twelve low-achieving students in a sixth grade compensatory education class participated in this 10-week project on problem solving with calculators. Students worked in groups of four for one 30-minute period a week; the first five sessions were in conjunction with the regular mathematics program, while researcher-developed activities were used in the latter weeks. Growth in problem-solving achievement was exhibited by seven members of the calculator group and 8 control group students. However, the growth of the calculator group was significantly higher than that of the control group.

[Achievement, Elementary (grade 6), Problem solving, Research]

Knowles, Frank. Coloured Rods, a Calculator and Decimals. Mathematics Teaching 86: xxviii-xxxii; March 1979.

The use of calculators plus Cuisenaire rods provided a natural introduction to decimals.

[Decimals]

Kobrin, Beverly. The Hand-Held Calculator: Effects on Intermediate Grade Mathematics Achievement. (Brigham Young University, 1978.) Dissertation Abstracts International 39A: 3354; December 1978.

In grades 4-6, the experimental group (n = 75) used calculators from October 1977 through 1978 at least one hour per week on selected calculator activities, while the control group (n = 141) did not use calculators. Analysis of covariance indicated no significant differences in achievement between groups.

[Achievement, Elementary (grades 4-6), Research]

Koller, Elayne Z. and Mulhern, Thomas J. Use of a Pocket Calculator to Train Arithmetic Skills with Trainable Adolescents. Journal for Special Educators of the Mentally Retarded 13: 134-138; Winter 1977.

(See also: Education and Training of the Mentally Retarded 12: 332-335; December 1977.

A rationale for the use of calculators with trainable adolescents is presented, with a description of a pilot study assessing an approach to teaching addition and subtraction to six moderately retarded students. A detailed presentation of the program used is included.

[Addition, Handicapped (retarded), Junior high, Research (pilot study), Subtraction]

Kolpas, Sidney J. The Use of Electronic Calculators as In-Class Instructional Aids in a Ninth-Grade Arithmetic Program. Unpublished doctoral dissertation, University of Southern California, 1978.

Eighty ninth-grade low- and under-achievers in four arithmetic classes participated in this 20-week study. The two experimental classes used calculators as instructional aids and as the sole solution-source for 50 percent or for 75 percent of each in-class assignment, while control classes (from another school) did not use calculators. The Comprehensive Test of Basic Skills was given as the pre- and posttest, and a researcher-constructed test was completed twice (first by hand, then with calculators to correct). No significant differences were found on the standardized test; significant differences on the researcher-constructed test favored the experimental groups both with and without calculators.

[Achievement, Low Achievers, Remedial, Research, Secondary (grade 9), Testing]

Koop, Janice Baker. A Description of the Effects of the Use of Calculators in the Community College Arithmetic Class. Unpublished doctoral dissertation, University of Colorado, 1978.

Six classes (N = 150 community college students) enrolled in one of three time periods, and were then randomly assigned to treatments for nine weeks. Students recorded time spent on homework; instructors detailed time spent on each topic and activity, with one group using calculators for all class, homework, and testing activities. No significant differences were found between groups on problem solving or computation. A treatment-by-age interaction was found for problem solving and total test, favoring younger students. No significant difference in attitudes toward mathematics or self-confidence were found, but the calculator group had significantly more positive attitudes toward calculators. No significant differences were found on the retention test (six weeks later). The calculator group spent less time doing homework and going over homework in class, and 50 percent more time on problem solving.

[Achievement, Attitudes, College, Research]

Krause, Marina C. Stepcounter. Calculators/Computers 2: 26-28; January 1978.

A calculator is used as a counter in activities for levels 4-8 for determining the student's paces per kilometer and relating the metric system to the student's own life.

[Elementary (grades 4-6), Junior high (grades 7-8), Measurement]

Krause, Marina C. The Calculator Plot. Calculators/Computers 2: 15-21; May 1978.

Two worksheets are presented, designed to use the calculator in solving problems with decimal fractions and graphing the solutions to discover mystery pictures.

[Decimals, Problem solving]

Kreinberg, Nancy. EQUALS in Math. Independent School 37: 47-49; May 1978.

Described is a teacher-training programming (grades 4-9) to promote nonsexist mathematics instruction and counseling. Manipulative materials, computers, and calculators were used.

[Course description, Teachers (preservice)]

Krist, Betty J. and Jewell, Wallace F., Jr. A New Look at 0^0 . Buffalo: State University of New York at Buffalo, 1978. Xerox copy.

Reasons for exploring 0^0 are discussed, and then the role of calculators in examining the problem is presented.

[Powers]

Kremer, Ronald. The Bicentennial Calculator. Mathematics Teacher 69: 463; October 1976.

An addition activity based on the calculator keyboard is described.
[Activities, Addition]

Kruse, Harry Rudolph and Burkett, Hugh Alan. Investigation of Card Programmable and Chip Programmable Pocket Calculators and Calculators Systems for Use at Naval Postgraduate School and in the Naval Establishment. Master's thesis, Naval Postgraduate School, Monterey, California, March 1977.

The usefulness of card-programmable hand-held calculators in the management curricula of the Naval Postgraduate School and in the fleet were investigated, using manufacturer-provided information, NPS classroom experimentation, "hands-on" programming, interviews, and other literature. All aspects of calculator functions, programming, and programmability were surveyed with particular emphasis on educational and practical applications. It was concluded that calculators provide significant advantages in teaching or learning mathematical concepts and that they are potentially important management and tactical support tools navy-wide. In addition, "thinking process transmutation," discovered in this study, is concluded to be an inevitable and important by-product of calculator programming which significantly improves the user's overall analytic capacity.

[College, Naval applications, Programmable calculators, Research, Roles]

LaBar, Martin; Wilcox, Floyd; and Rickman, Claude M. Programmable Calculators as Teaching Aids and Alternatives to Computers. School Science and Mathematics 74: 647-650; December 1974.

The authors provide a list of calculators which have a capacity for handling programs, and a list of programs for such calculators which are available at cost. They argue that the use of these materials at many levels of mathematics instruction enhances both motivation and understanding.

[Programmable calculators, Selection]

LeBarre, James, et al. Machine Calculation of Business Problems. Stenospeed, Inc., 1975.

[Business]

Lachenbruch, David. Looking Ahead. Radio Electronics 49: 4; August 1978.

The "evolution" of calculators is briefly traced, with note of changing sophistication levels.

[History, Selection]

Ladd, Norman Elmer. The Effects of Electronic Calculators on Attitude and Achievement of Ninth Grade Low Achievers in Mathematics. (Southern Illinois University, 1973.) Dissertation Abstracts International 34A: 5589; March 1974.

Two-hundred-one low achievers were randomly scheduled into one of five control sections or one of five experimental sections. All groups followed the same lesson sequence, with control groups using only paper-and-pencil for all calculations and experimental sections using electronic calculators. Significant differences were found on both attitude and achievement tests from pre- to post-treatment for both groups, but no significant differences in posttest mean scores were found between groups.

[Achievement, Attitudes, Desk calculators, Low achievers, Research, Secondary (grade 9)]

Ladd, Norman E. Working with the Calculator in Beginning Algebra. Skokie, Illinois: National Textbook Co., 1976.

This workbook includes exercises on formulas, exponents, evaluating expressions, operations with integers and fractions, solving equations, prime factors, GCD and LCM, multiplying and factoring polynomials, linear equations, irrational numbers, Pythagorean Theorem, distance and midpoint formulas, and the quadratic formula. A teacher's guide with answer key is included.

[Algebra, Secondary, Worksheets]

LaMont, M. Dean, et al. Calculating Better Decisions. Dallas: Texas Instruments, Inc., 1977.

[Activities]

Lander, Kathleen. Printing Calculators for Show-and-Save Records. Popular Science 212: 59-61; January 1978.

Characteristics of 20 printing calculators are presented and discussed.

[Selection]

Lappan, Glenda and Winter, Mary Jean. A Calculator Activity That Teaches Mathematics. Arithmetic Teacher 25: 21-23; April 1978.

A variation of Bingo is given, with directions for the calculator activity and extensions.

[Games]

Laursen, Kay William. Use of Calculators in High School General Mathematics: A Study Comparing Achievement, Attitude, and Attendance of General Mathematics Students Who Used Calculators with Students Who Did Not. (Brigham Young University, 1978.) Dissertation Abstracts International 39A: 733; August 1978.

From five schools with 18 general mathematics classes which had classroom sets of calculators, nine classes were randomly assigned

to use calculators while nine other classes used paper-and-pencil methods of computation. Analyses of variance and covariance using pre-posttest data indicated that greater gains were made by students using calculators. However, no significant differences were found in attitudes or attendance.

[Achievement, Attitudes, General mathematics, Research, Secondary (grade 9)]

Lavoie, F. J. Calculators and Computers. Machine Design 40: 184; 1968.

[Desk calculators, Selection]

Lavoie, F. J. Vest-Pocket Calculators. Machine Design 44: 126; 1972.

[Selection]

Lawson, Thomas James. A Study of the Calculator's and Altered Calculator's Effect upon Student Perception and Utilization of an Estimation Algorithm. (State University of New York at Buffalo, 1977.) Dissertation Abstracts International 39A: 647; August 1978.

Seventh-grade students from one junior high school were randomly assigned to use paper and pencil, a four-function calculator, or an altered calculator (with the function of the four operation keys masked). The four-day "interim work experience" was a 16-item computational task. Using analysis of variance, it was found that (1) computational ability correlated positively with ability to estimate, (2) the treatment had no effect on estimation ability, (3) students with low computational ability made the greatest number of errors when using calculators, and (4) altering the keyboard had no significant overall effect on ability to use calculators. Videotape analysis of students working indicated that many did not use estimation to verify answers. Interview information is also provided.

[Estimation, Four-function calculators, Research, Secondary (grade 7)]

Lazarus, Mitchell. Reckoning with Calculators. National Elementary Principal 57: 71-77; January 1978.

Calculators in school need not cause decline in either practical skill or mathematical understanding. With the right curriculum materials, they can help bring about major improvements in mathematics education.

[Roles]

Leaton, Pip. Two Uses for Electronic Calculators. Mathematics Teaching 71: 49; Summer 1975.

Methods for calculating square roots and logarithms are illustrated.

[Logarithms, Roots]

Leitzel, Joan and Waits, Bert. Hand-Held Calculators in the Freshman Mathematics Classroom. American Mathematical Monthly 83: 731-733; November 1976.

A college-level remedial mathematics course is described in which students were required to use calculators as a part of their course work.

[College, Course description, Remedial]

Lenhard, Rodger William. Hand-Held Calculators in the Mathematics Classroom at Stuart Public School, Stuart, Nebraska. (Montana State University, 1976.) Dissertation Abstracts International 37A: 5661; March 1977.

Analysis of at least eight tests taken by 125 students in grades 7 through 12 showed no differences in performance between those using and those not using calculators during the test on test scores, concept and computation errors, attitudes, time, and rank.

[Achievement, Attitudes, Junior high, Research, Secondary]

Lesjack, J. J. Computation: Beat the Machine. Grade Teacher 87: 150-153; March 1970.

A game in which teams of students compete with each other using an adding machine can be used to practice and enhance basic skills.

[Desk calculators, Elementary (grade 5), Games]

Levy, L. S. How to Make Your Calculator Think Like a Computer. Machine Design 49: 62; 1977.

[Building]

Lewis, Gordon M. C. You, Your Students, and Basic Skills. District of Columbia Council of Teachers of Mathematics Newsletter 7: ; November-December 1977.

[Roles]

Lewis, J. A Review of Scientific Calculators. School Science Review 56: 412-414; December 1974.

A table is provided which lists the facilities available on 17 different calculator models.

[Scientific calculators, Selection]

Lewis, J. A Further Review of Scientific Calculators. School Science Review 56: 625-628; March 1975.

Eighteen calculators available in Britain are analyzed.

[Selection, Scientific calculators]

Lewis, J. A Review of Scientific Calculators for Schools (May 1975). School Science Review 57: 177-182; September 1975.

The author indicates that the calculator as a tool has an assured place in science teaching and gives examples of its use. Eighteen calculators are evaluated.

[Science, Scientific calculators, Selection, Roles]

Lewis, J. Essential and Desirable Features on Electronic Calculators for Use in Schools for the 11-16 Year Range. Mathematics in School 6: 34-35; November 1977.

[Secondary, Selection]

Lewis, John. Use of Electronic Calculators in Science Examinations. Education in Science 73: 19; 1977.

[Science, Testing]

Lewis, Philip. Minicalculators Have Maxi-impact. Nation's Schools 93: 60, 62; May 1974.

The pocket calculator is not only cheaper and more convenient than the calculators of a few years ago; it can also do more. It may revolutionize education by saving students and teachers a great deal of computational time. Checking answers will become routine. Students may even use mathematics outside of class. When buying calculators, several optional features should be sought: built-in battery recharger, battery drain indicator, display cut-off, decimal capability, numeric display indicator, high impact plastic housing, and warranty. An increasing number of models and extra features are available.

[Roles, Selection]

Lichtenberg, Donovan R. Minicalculators and Repeating Decimals. Mathematics Teacher 71: 524-530; September 1978.

The calculator is used to determine repeating decimals; several theorems and examples are provided.

[Decimals]

Lieblich, Gerald S. Pros and Cons of the Handheld Calculator. MATYC Journal 12: 199-203; Fall 1978.

Arguments for using or not using calculators are presented through comments on various articles and research studies.

[Pros/cons]

Likens, Stephen F. Review of Research Investigating the Educational Value of Calculators. Columbus: The Ohio State University, May 1977. Xerox copy.

This paper, submitted to fulfill requirements for a seminar, reviews 29 studies based on use of the calculator.

[Research (review)]

- Lim, James K. and Tseng, M. S. The Electronic Pocket Calculator-- A Significant Factor in Students' Performance of Pharmaceutical Calculations? American Journal of Pharmaceutical Education 40: 14-16; February 1976.

The possible subtle influence of calculators in the routine evaluation of the arithmetical proficiency of students is noted. Results of a study with a class of 71 first-year professional pharmacy students taking a two-credit pharmaceutical calculations course are interpreted.

[College, Pharmacy, Research]

- Lim, J. K.; Baldwin, J. H.; and McCormick, W. C. Report of a National Survey on Use of Pocket Calculators in AACP Member Schools and in State Board Examinations. American Journal of Pharmaceutical Education 41: 327; 1977.

[College, Pharmacy, Research (survey)]

- Lindsay, Robert L. Black Box Numeracy. Mathematics in School 4: 26-28; November 1975.

The effect of the use of hand-held calculators on the arithmetic curriculum is explored.

[Roles]

- Lindsay, Ian D. Calculators in Perspective. Mathematics in School 4: 6-7; September 1977.

[Roles]

- Lipsey, Sally I. Polynomial Equations and the Pocket Calculator, Texas Mathematics Teacher : 3-4; March 1978.

[Algebra, Secondary]

- Litwiller, Bonnie H. and Duncan, David R. Calculations You Would Never Make Without a Minicalculator. Mathematics Teacher 70: 654-656; November 1977.

Ten problem-solving activities are presented which involve large numbers and real data, written for use with a calculator.

[Problem solving]

- Lloyd, Phil. Activity: Calculator Words and Picture Title. New Zealand Mathematics Magazine 15: 35-36; May 1978.

Two worksheet-type activities are given.

[Activities, Worksheets]

- Locke, Flora M. Electronic Calculators for Business Use, New York: John Wiley & Sons, 1978.

[Business, Selection]

Locke, Flora M. and Dehr, Dorothy. Office Calculating and Adding Machines. New York: John Wiley & Sons, Inc., 1974.

[Business, Desk calculators]

Longstaff, F. R. et al. Desk Calculators in the Mathematics Classroom. June 1968. ERIC: ED 029 498.

This study was designed to test the use of calculators with two groups of ninth graders and one group of fifth graders. The findings were equivocal, concerning the effect of calculators on students' performance, self-confidence, and attitudes toward mathematics. Teacher enthusiasm for calculator use was unrelated to student performance. Teacher enthusiasm was highest in classes of low-average IQ. While some teachers felt calculators interfered with their daily operations, others felt that the productivity of students increased, especially among those previously incapable of producing. Classroom behavior problems were eased.

[Achievement, Attitudes, Desk calculators, Elementary (grade 5), Research, Secondary (grade 9)]

Lorthup, Larry L. and Jones, Edwin C., Jr. Pocket Calculators in Engineering Education. In Teaching Aids in the College Classroom (Lawrence P. Grayson and Joseph M. Biedenbach, editors). Washington: American Society for Engineering Education, 1975. ERIC: ED 113 173. 137 pp.

Questions about the use of calculators in the engineering classroom are discussed, a freshman-year course in engineering computation emphasizing calculators is described, and features needed for calculators used in engineering are listed.

[College, Course description, Engineering, Selection]

Lowerre, George F.; Scandura, Alice M.; Scandura, Joseph M.; and Veneski, Jacqueline. Using Electronic Calculators with Third and Fourth Graders: A Feasibility Study. School Science and Mathematics- 78: 461-464; October 1978.

Instruction of three children for a ten-week period with place value, negative numbers, estimation, decimals, and other topics resulted in substantial gains in achievement on a standardized test. Topics to teach using calculators and implications for problem solving are discussed.

[Elementary (grades 3,4), Research]

Lowry, William. The Hand-Held Calculator and Teacher Education in Virginia. Virginia Mathematics Teacher, 1977.

Results of a questionnaire sent to teacher training institutions in Virginia showed that the majority of prospective elementary and secondary school mathematics teachers in Virginia institutions can and do use hand-calculators to some extent. Most institutions do not give any instruction on how to use the calculator per se; but about half give some instruction on one

or more of the following: how to use the calculator with students, arguments for and against using calculators in school, and the possible effects of the use of calculators on the mathematics curriculum development.

[College, Research (survey), Teachers (preservice)]

Lunder, Dennis A. The Impact of the Calculator on Test Anxiety for High School Consumer Mathematics Students. (University of Denver, 1978.) Dissertation Abstracts International 39A: 6607; May 1978.

Consumer mathematics students (n = 159) in grades 9-12 in three schools were randomly scheduled into two experimental groups (using calculators) or two control groups (not using calculators). One experimental and one control group used calculators on the posttest, while the other two groups did not. Analysis of covariance indicated that allowing use of calculators on the posttest improved achievement. The group using calculators for instruction and the test scored higher than the group not using calculators for instruction but using them on the test. Test anxiety was also explored; use of the calculator did not significantly reduce anxiety.

[Anxiety, Research, Secondary (grades 9-12), Testing]

Luxton, Karen and Spungin, Susan Jay. Effectiveness of Calculator Instructional Materials: A Pilot Study. New Outlook for the Blind 70: 380-384; November 1976.

During this four-week study, 15 blind and partially sighted students aged 15 to 21 used and evaluated the instructional manuals for three calculators: the TSI Speech Plus, the Master Specialty Audio Response, and the AFB Braille calculator. Data indicated that the students were able to use the cassette manuals to learn to use each calculator. Several suggested improvements for future development of materials are given.

[Handicapped (blind), Research, Secondary]

Machlowitz, Eleanore. Electronic Calculators--Friend or Foe of Instruction? Mathematics Teacher 69: 104-106; February 1976. (See also: Education Digest 41: 46-48; April 1976.)

Some thoughts on the classroom use of hand calculators are offered, together with advice on their purchase and references to related research.

[Roles, Selection]

Madaus, H. S. and Yrle, A. C. Developing Proficiency in Ten-key Touch Operation. Business Education Forum 30: 10-11; April 1976.

[Business education]

Madison, Arnold and Frotar, David L. Pocket Calculators: How to Use Them and Enjoy Them. New York: Thomas Nelson, Inc., 1978.

This book is designed to assist users in choosing the "right" calculator and making effective use of it.

[Selection]

Maier, Eugene. Folk Math. Instructor 86: 84-92; February 1977.

Along with several suggestions concerning teaching mathematics for "real-world" use, the role of the calculator is discussed briefly.

[Roles]

Maindonald, John. The Continuing Saga of the Handheld Calculator. New Zealand Mathematics Magazine 15: 48-50; September 1978.

[Roles]

Majumdar, Badiul Alam. Innovations, Product Developments and Technology Transfers: An Empirical Study of Dynamic Competitive Advantage: The Case of Electronic Calculators. (Case Western Reserve University, 1977.) Dissertation Abstracts International 38A: 2926; November 1977.

The electronic calculator industry was studied with respect to international trade and transfer of technology.

[Marketing, Research]

Mansilla, Carlos Alberto. Curso de Mestrado em Ensino de Ciencias e Matematica. Paper prepared for Ensenanza de la Computacion en Escuelas Secundarias de la Provincia del Chaco, Republica Argentina, 1977.

The paper discusses general considerations related to the status of calculators, the role of computation in education, and justifications for the use of calculators. A description of the project, objectives, strategies for implementation and evaluation, and other information is included.

[Curriculum, Roles]

Maor, Eli. The Pocket Calculator as a Teaching Aid. Mathematics Teacher 69: 471-475; October 1976.
(See also: Reader Reactions, Mathematics Teacher 70: 291; April 1977, for comments on convergence as "seen" on a calculator.)

Suggestions are given for using calculators for computations too trivial for computer processing but too time-consuming for hand calculation. Several examples from arithmetic, algebra, and calculus are included.

[Activities]

Maor, Eli. The History of on the Pocket Calculator. Journal of College Science Teaching 6: 97-99; November 1976.

Historical information on π is presented in the context of a classroom experience using calculators to calculate π .

[College, Geometry]

Maor, Eli. A Children's Summer Course with the TI-57 Programmable Calculator. Press release, University of Wisconsin-Eau Claire, 3 October 1978.

This is the description of the special six-week summer mathematics course offered in Eau Claire, Wisconsin for upper elementary and junior high school children. It was designed as an enrichment program to enhance interest and motivation; thus, it stresses ideas and concepts, rather than techniques and rote learning. Thirty-four students participated in two sections, ages 8-11 and ages 12-15. The syllabus for the course is included with a detailed description of how the topics were taught.

[Course description, Elementary, Gifted (enrichment), Junior high, Programmable calculators]

Marsh, James S. and Smith, Richard C. Computer Holograms with a Desk-Top Calculator. American Journal of Physics 44: 774-777; August 1976.

The use of computer-generated holograms to calculate the Fourier transforms of simple stick objects are discussed.

[Desk calculators, Physics]

Marshall, John and Hussey, Greg. Light-Activated Timer Made From a Pocket Calculator. Physics Teacher 16: 323-324; May 1978.

Described are the necessary procedures and equipment needed to modify a calculator timer so that it can be controlled photo-electrically.

[Building, Physics, Secondary]

Mason, Marguerite. The Hand-held Calculator in the Elementary School, an Exploratory Study of Two Issues: Dependency and the Effect on the Problem-solving Processes. In Research Reporting Sessions, NCTM 57th Annual Meeting. Columbus, Ohio: ERIC/SMEAC. March 1979. Pp. 49-51.

Two pairs of students, matched on mathematics pretests, were chosen at each grade level from 2-6. One student from each pair was from an experimental class which used calculators, and the other from the control class which did not use calculators. Each student was given a set of computational exercises and five word problems to solve in an interview approximately once a month. All students had a calculator available. The mode used to solve exercises and problems was recorded. There was no evidence that students became calculator dependent. Follow-up tests showed that it was advantageous to have calculators available for certain types of exercises such as division for third graders.

[Elementary (Grades 2-6), Problem solving, Research]

Mastbaum, Sol. A Study of the Relative Effectiveness of Electric Calculators or Computational Skills Kits in the Teaching of Mathematics. (University of Minnesota, 1969.) Dissertation Abstracts International 30A: 2422-2423; December 1969.

The calculator, when used as a teaching aid with slow learners in mathematics in the seventh and eighth grades, did not significantly improve attitude, increase mathematical achievement, or increase non-calculator computational skill, mastery of mathematical concepts, or ability to solve mathematical problems. However, the students did at least as well in all areas as those students not using calculators.

[Achievement, Attitudes, Desk calculators, Junior high (grades 7-8), Low achievers, Research]

Mcanelly, James Robert. A Study of the Mathematical Competencies Considered Important by Supervisors in Large Retail Firms in the Metropolitan Area of Chicago. (Northern Illinois University, 1978.)
Dissertation Abstracts International 39A: 3314-3315; December 1978.

Supervisors in large retail firms rated the competency in the proficient use of electronic hand-held calculators and/or calculating machines as the most important competency.

[Achievement, Business, Post-secondary, Research (survey)]

McCarthy, D. P. Comparative Evaluation of Pocket Calculators, Report No. CSC-77-03. Ireland: University of Dublin, May 1977.

Different elements of a pocket calculator are presented to aid the potential buyer in assessing the usefulness of a pocket calculator.

[Selection]

McCarty, George. Calculator Calculus. Palo Alto, California: Page-Ficklin Publishing Co., 1975.

[Calculus, College]

McCarty, George. Squares, Square Roots, and the Quadratic Formula. Calculators/Computers 2: 82-89; January 1978.

This article, a portion of Chapter 1 from Calculator Calculus, presents a repetitive method for approximating square roots using the calculator.

[Roots]

McCluggage, D. Calculators: Mini-Calculators. American Home 76: 25-26; April 1973.

Uses of hand-held calculators are discussed in this article.

[Roles]

McCready, Richard R. Solving Business Problems with Calculators (Fourth Edition). Belmont, California: Wadsworth Publishing Co., Inc., 1972; Fifth Edition, 1977.

[Business, Desk calculators, Secondary]

McEvoy, Michael. Calculator Spelling Tricks. Livermore, California: Idea-Fire Publishing, 197 .

[Activities]

McHale, Thomas J. and Witzke, Paul T. Calculation and Calculators. Reading, Massachusetts: Addison-Wesley Publishing Co., 1978.

[Activities]

McKellips, Terral. What Are We Going to Do About Calculators? Oklahoma Council of Teachers of Mathematics Newsletter : 4-5; Fall, 1974.

[Roles]

McLeod, Douglas B. and Adams, Verna M. Aptitude-treatment Interaction in Mathematics Instruction Using Calculators. 1979. ERIC: SE 026 827.

Students in three mathematics classes for prospective elementary teachers were assessed on two aptitudes, field independence and general reasoning, and randomly assigned to either an expository (n = 24) or a discovery (n = 23) treatment. The expository treatment used a deductive sequence of instruction and provided maximal guidance; the discovery group used an inductive sequence with minimal guidance, using calculators to help students discover concepts and rules independently. The instruction involved errors in measurement and calculations with approximate data. A significant interaction was found with general reasoning on the retention test, as predicted. There were no interactions with field independence.

[College, Elementary, Research, Teachers (preservice)]

McShane, Jane. Electric Calculators; Business Education; 7718.06. (Quinnester Course, Dade County Public Schools, Miami, Florida.) 1972. ERIC: ED 097 570.

A course was developed to instruct business students in the use of mechanical and electronic printing calculators, and electronic display calculators. Performance objectives, course content, suggested activities, evaluative instruments, and resource materials are described.

[Business education, Course description, Desk calculators]

McWhorter, Eugene W. The Small Electronic Calculator. Scientific American 234: 88-98; March 1976.

Details are given concerning the inner workings of the electronic calculator.

[Building]

McWilliam, I. G. Programmable Calculators. Journal of Chemical Education 51: 482-484; July 1974.

The use of programmable calculators for the simulation of experiments is discussed, with five examples of specific applications provided.

[Chemistry, Programmable calculators, Roles]

Meconi, L. J. Using the Hand-Held Calculator in Industrial Education. Industrial Education 66: 22-23; February 1977.

Several examples of elementary technical problems in which students can use calculators are given: finding average monthly sales, dealing with lengths and with circuits, figuring percents, and converting from English to metric units.

[Business, Industrial education]

Meehan, James R. et al. Solving Business Problems on the Electronic Calculator. New York: McGraw-Hill, 1975.

[Business]

Meissner, H. Literature zum Thema Taschenrechner. Münster: TIM, October 1976.

A bibliography of calculator articles, research, and books is presented.

[References (selected)]

Meissner, H. Rechenschaftbericht der Projektgruppe TIM für das Jahr 1976. Münster: TIM, 1976.

Activities of TIM during 1976 are reported.

[Curriculum]

Meissner, Hartwig. Welcher Taschenrechner ist am besten? Neue Unterrichtspraxis, March 1977.

Concerned with which calculator is best for early mathematical education, Project TIM tested about 30 pocket calculators from about 20 manufacturers. Classroom experiences with calculators are reported. A catalog of calculator features is included in the appendix.

[Selection]

Meissner, H. Der mathematische und naturwissenschaftliche Unterricht. MNU, April 1977.

Calculator selection is discussed.

[Selection]

Meissner, H. Erlasse Taschenrechner im Mathematikunterricht. MNU, June 1977.

German calculator projects are described.

[Curriculum]

Meissner, Hartwig. Kriterien Katalog zum Test von Taschenrechnern. Neue Unterrichtspraxis, June 1977.

Calculator selection is discussed and features of calculators are listed.

[Selection]

Meissner, Hartwig. Taschenrechnerreport. Zentralblatt für Didaktik der Mathematik 9: 111-114; June 1977.

This report gives a survey about international problems and activities in using a simple non-programming calculator in mathematics education. The information originates from the literature, from correspondence, and from discussions at the Third International Congress on Mathematics Education in Karlsruhe in 1976.

[Roles]

Meissner, Hartwig. Der Taschenrechner als methodisches Hilfsmittel im Kindergarten, in der Grundschule und in der Hauptschule. (The Calculator as a Method of Help in the Kindergarten, the Elementary School, and the High School.) Münster: TIM, 1977.

Curriculum is discussed and some instructional activities described.

[Activities, Curriculum, Elementary, Secondary]

Meissner, Hartwig. Project TIM (Taschenrechner Im Mathematikunterricht). Münster: TIM, 1977.

A survey of activities of the German working group TIM is presented. Titles of 10 German-written reports are given, with short abstracts for each written in English.

[Curriculum]

Meissner, Hartwig. Kurzbericht (Über die wissenschaftlichen Ergebnisse einer Reise in die Vereinigten Staaten von Amerika (10.3.1978-18.6. 1978) zum Thema "Der Taschenrechner im Mathematikunterricht für 5-12-jährige Kinder (TIM 5/12)". (Short Report Concerning the Scientific Results of a Trip in the United States,...). Münster: TIM, 1978.

(See also: Zentralblatt für Didaktik der Mathematik 10: 221-229; December 1978.

Comments on the author's visit to American calculator projects are included, plus comments on the use of calculators in general.

[Curriculum, Elementary (grades k-6)]

Meissner, H. Projekt TIM 5/12 - Taschenrechner im Mathematikunterricht für 5- bis 12-Jährige. Zentralblatt für Didaktik der Mathematik 10: no. 4, 1978.

[Curriculum, Elementary (grades k-6)]

Meissner, Hartwig. Activities to Use a Hand-Held Calculator in School Mathematics in Grades K-6 (Age 5-12). Münster: TIM, 1978.

References and a list of activities for various content areas or topics are included in this bulletin.

[Activities, Elementary (grades k-6), References (selected)]

Meissner, Hartwig. Problem Solving with the ONE WAY PRINCIPLE. Münster: TIM, 1978.

[Problem solving, Properties]

Meissner, Hartwig. Vorschläge zum Taschenrechnereinsatz bis Klasse 7. (Suggestions for the Introduction of the Pocket Calculator through the Seventh Grade.) Münster: TIM, 1978.

The use of calculators in elementary schools is discussed, with examples of how they can be used to develop mathematical ideas.

[Activities, Curriculum, Elementary, Four-function calculators]

Meissner, H. Bibliography on Calculators. Münster: TIM, March 1979.

Books and articles in English are included in this listing.

[References (selected)]

Meissner, H. Literatur über einfache Taschenrechner, Stand 1/79. Münster: TIM, April 1979.

Books and articles (published and unpublished), largely from German sources, are included on this listing.

[References (selected)]

Meissner, H. Elektronische Taschenrechner als methodisches Hilfsmittel. Münster: TIM.

[Curriculum]

Meissner, Hartwig. Taschenrechner als Lehrmittel. Münster: TIM.

This report gives a survey of the possibilities of using the hand-held calculator with students from the elementary school level through university level.

[Roles]

Meissner, Hartwig; Arens, Elisabeth; and Vogt, Christiane. Der Taschenrechner als methodisches Hilfsmittel im Mathematikunterricht der Grundschule.

[Curriculum, Elementary]

Mendoza, Eric. Pocket Calculators and Numerical Methods in Physics Teaching. School Science Review 56: 718-733; June 1975.

Ways in which a physical problem can be tackled using numerical methods are explained using examples from simple harmonic motion, large oscillations of a pendulum, and Newtonian orbits.

[Activities, Physics]

Merchant, Ronald. Adding Machines and Calculators. New York: John Wiley & Sons, 1974.

This guide for both standard and electronic calculators shows the fundamental business procedures applicable to all machines and reviews basic business mathematics concepts.

[Business education, desk calculators]

Meserve, Bruce E. and Sobel, Max A. Contemporary Mathematics. Englewood Cliffs, New Jersey: Prentice Hall, 1977.

A chapter on calculators and computers is included.

[Activities]

Meyer, Martin. Now...Build the Senior Scientist Calculator. Popular Electronics 8: 33-38; October 1975.

Schematic drawings of the circuitry for the "Senior Scientist" calculator are provided, functions and capabilities of the calculator are described, and instructions for constructing the calculator from a kit are given.

[Building, Scientific calculators]

Meyer, Martin. Now You Can Build a Scientific Programmable Calculator. Popular Electronics 9: 36-38; May 1976.

Features of a full scientific, 72-step programmable calculator are described, with a parts list and schematic diagram of the calculator included. Three examples (hyperbolic sine, SKIP function, and quadratic formula) are given to show how the programming works.

[Building, Programmable calculators, Programming]

Michelow, Jaime S. and Vogeli, Bruce R. The New World of Calculator Functions. School Science and Mathematics 78: 248-254; March 1978.

The importance of functions is discussed and specific illustrations of the calculator as a function generator are presented.

[Functions]

Michigan. Uses of the Calculator in School Mathematics, K-12. Monograph No. 12. Lansing: Michigan Council of Teachers of Mathematics, March 1977.

Part I covers desirable features of calculators for classroom use, basic assumptions on classroom use, and curriculum concerns. Part II is a collection of activities, organized under the following categories: Grades K-3, Grades 4-8 (number-numeration, whole number basic operations, common fractions and decimal fractions, integers, and supplementary materials), and Grades 9-12 (pre-algebra and algebra, geometry through higher mathematics). A bibliography is included.

[Activities, Elementary (grades k-6), Roles, Secondary (grades 7-12)]

Miller, Don. Calculator Explorations and Problems. New Rochelle, New York: Cuisenaire Company of America Inc., 1979.

(See also: Miller, Don. Calculator Explorations. St. Cloud, Minnesota: Don Miller, 1977.)

The activities in this book were designed to make the calculator an integral part of the mathematical ideas being explored. Many use

the calculator to generate data which suggest interesting number patterns that lead to further discoveries and generalizations. Others use the calculator to provide immediate feedback to improve estimation and mental computational skills.

[Activities, Elementary (grades 4-6), Secondary (grades 7-12)]

Miller, Donald Peter. Effectiveness of Using Minicalculators as an Instructional Aid in Developing the Concept and Skill of Long Division at the Fifth Grade Level. (The Florida State University, 1976.) Dissertation Abstracts International 37A: 6327; April 1977.

Two fifth-grade classes were separated into a low group and a high group on the basis of a prerequisite skills test of multiplication, subtraction, and division by one-digit divisors. One class was chosen to use calculators during a 12-day unit on division, while the other class was permitted the use of multiplication tables. The low groups were taught by regular classroom teachers and the high groups were taught by an elementary education major. The low calculator group scored significantly higher than the low control group on posttests of prerequisite skills and division.

[Achievement, Division, Elementary (grade 5), Research]

Miller, Doris I. Simulation of Sports Techniques by Digital Computer and Programmable Calculator. Journal of Health Physical Education Recreation 45: 65-67; March 1974.

The use of calculators and computers in physical education is described.

[Physical education, Roles]

Miller, Lloyd E. Practice Problems for Business Education Using Electronic Calculators. Paramus, New Jersey: Sharp Electronics Corp., 1975.

[Business education, Problem solving]

Miller, Paul E. How to Use the HP-45 Calculator as a Stopwatch or Elapsed-Time Indicator. Popular Electronics 9: 67; June 1976.

Directions are given for gaining access to the clock function in the Hewlett-Packard 45 calculator. A method of using the function for timing and storing elapsed times of up to nine separate events is described. The accuracy of the HP-45 as a timer is discussed.

[Building]

Miller, R. Make a Giant Step Forward with the Latest in Electronics Technology: The Mini-calculator. Man/Society/Technology 33: 5-6; September 1973.

The potential of the use of calculators is discussed.

[Roles]

Miller, Robert P. Some Thoughts on Traditional Concepts in Teaching Accounting. Journal of Business Education 51: 35-36; October 1975.

Reasons for and against the use of calculators in an accounting class are given, and a compromise solution is suggested.

[Business education, College, Pros/cons]

Miller, William A. and Hazekamp, Donald W. Calculator Graphing. Mathematics Teacher 71: 759-762; December 1978.

Three worksheets provide experiences in using calculators to compute squares, reciprocals, and square roots, plus rounding numbers to the nearest hundredth, plotting points, and drawing graphs.

[Junior high (grades 7-9), Reciprocals, Roots, Secondary, Worksheets]

Millikin, G. and Siegel, D. Kit for Teaching Calculating and Computing Devices. Teaching Exceptional Children 3: 17-22; Fall 1970.

A kit was designed to introduce gifted students to basic computer activities. The kit included an abacus, slide rule, desk calculator, punch-card equipment, and an electronic computer, as well as books. A series of objectives and activities is outlined.

[Desk calculators, Gifted, Junior high (grades 7-8), Kit, Units]

Mims, F. Calculators: From the Abacus to the Electronic Calculator. Radio-Electronics 43: 51-54; December 1972.

The development of calculating machines is traced.

[History]

Mims, F. \$20 Mini-computer Revolution. Science Digest 75: 41-45; May 1974.

Due to rapidly advancing technology, especially the development of silicon large-scale integration chips, the price of vestpocket calculators is going down, while the capability of these devices continues to increase. Calculator manufacturers are now working on streamlining the pocket models even more, and perfecting keyboard design. Advanced scientific and business pocket calculators are currently on the market, as are models which perform conversions between the metric and English systems of measurement. A somewhat large calculator with printout capabilities is available, and programmable calculators are being developed. In the future, calculators with large memories will be available. One pocket-sized machine will serve as a combination computer, telephone directory, notepad, calendar, and dictionary.

[Marketing, Selection]

Mims, Forrest M. Here Are the New Programmable Calculators! Popular Electronics 9: 29-35; May 1976.

Reverse Polish notation and algebraic methods of entry are discussed, plus branching and conditional-comparison capabilities of programmable calculators. A shopper's guide to four elementary programmables, three intermediate programmables, and two fully programmable models is provided. Sample programs for determining volume of a cylinder, for incrementing a number, for squaring consecutive integers with a display of each result, and for a Hi-Lo game are included.

[Calculator logic, Programmable calculators, Programming, Selection]

Mims, Forrest M. Number Machines: An Introduction to the Abacus, Slide Rule, and Pocket Calculator. New York: David McKay Co., Inc., 1977.

[Junior high (grades 7-9), Roles]

Minneapolis. East Area Calculator Project: Report on Activities 1976-77. Minneapolis Public Schools, East Area Curriculum Office. (Casey Withers Humphreys, Chairman.)

This report summarizes teachers' experiences with the use of the calculator in ninth- and tenth-grade general mathematics classes and in classes at other levels (senior mathematics, trigonometry and informal geometry, advanced mathematics, eighth-grade mathematics, and elementary mathematics). Specifications for calculators are given and logistics for the use of calculators in the classroom are described.

[General mathematics, Classroom management, Roles, Secondary (grades 9-10)]

Morgan, Raymond V. and Warnock, Tony T. Derivatives on the Hand-Held Calculator, Mathematics Teacher 71: 532-537; September 1978.

Some of the problems that arise in the use of calculators to illustrate derivatives are discussed, along with illustrations of numerical differentiation techniques.

[Derivatives]

Morris, Janet. More About Repeating Decimals. Calculators/Computers 2: 64-68; April 1978.

The investigation of decimal equivalents (see Billstein and Lott, 1978) is extended with three problems.

[Decimals]

Morris, Janet Parker. Problem Solving with Calculators. Arithmetic Teacher 25: 24-26; April 1978.

Activities using four-function calculators are classified by purpose: to explore number patterns, to discover relationships and develop concepts, to practice mental estimation, to reinforce inverse relationships, to solve application problems, to develop the "guess-then-check" technique, and for individual exploration and enrichment.

[Activities, Four-function calculators, Problem solving]

Mortari, Maria Thereza Cyrine and Polidoro, Maristela Poli. Projeto: "O Compromisso da Mini-Calculadora Com o Ensino de Matematica" (The Commitment of "Minicalculators" with Mathematical Education").
[Curriculum]

Moser, James M. The Effect of Calculator Supplemented Instruction on the Arithmetic Achievement of Second and Third Graders. In Research Reporting Sessions, NCTM 57th Annual Meeting. Columbus, Ohio: ERIC/SMEAC. March 1979. Pp. 29-31.

Subjects were children in grades 2 and 3 in eight classes in two schools. One school was implementing a traditional curriculum and the other used the DMP program. The calculator was used with the ongoing programs; teachers were given suggestions on how the calculator could be used, and kept a log which was validated by unannounced visitations. Amount of use of calculators ranged from 36 percent to 79 percent of instructional days, and from 16 percent to 48 percent of instructional minutes.

[Elementary (grades 2-3), Research, Time]

Moursund, David. Calculators, Computers, and Elementary Education, for Teacher Education. Salem, Oregon: The Math Learning Center, 1977. (See also: Moursund, David. Calculators, Computers, and Elementary Education. Preliminary Edition. Eugene, Oregon: Department of Computer Science, University of Oregon, February 1977.)

Background information on the development of calculators is given. The emphasis is on the uses of calculators in the elementary school classroom, with several activities appropriate for school use are suggested.

[Activities, Elementary, History, Roles, Teachers]

Moursund, David. Calculators in the Elementary School. Calculators/Computers 1: 7-10; May 1977. (See also: Moursund, David. Calculators in the Elementary School. Math Learning Center Report. Salem, Oregon, February 1977.)

Using the calculator as an aid in problem-solving situations is discussed, with suggestions for the classroom. Goals for teaching about calculators are stated, including mechanical aspects, capabilities, limitations, errors, problem solving, and when to use calculators.

[Problem solving, Roles]

Moursund, David. Calculator Arithmetic. Calculators/Computers 2: 36-41; April 1978.

The calculator number system, underflow and overflow, calculator arithmetic, integer arithmetic, working with fractions, use of memory, and other memory-like features are discussed, with 11 exercises included.

[Activities, Calculator logic, Roles]

Mullish, Henry. How to Get the Most Out of Your Pocket Calculator. New York: Collier Books, 1974.

This book describes how a calculator can be used by the average person. Such things as determining gas consumption of one's car, balancing a checkbook, shopping for best buys, computing interest, and similar topics are covered. A section on higher-priced calculators is included along with sample problems and answers.

[Consumer applications]

Mullish, Henry. The Complete Pocket Calculator Handbook. New York: Collier Books, 1976.

[Activities]

Mullish, Henry. How to Use a Pocket Calculator. New York: Arco Publishing Co., 1977.

A guide for students and teachers, this book indicates ways in which the calculator can be used.

[Activities]

Munson, Howard R. Your District Needs a Policy on Pocket Calculators! Arithmetic Teacher 25: 46; October 1977.

School systems are urged to formulate a system-wide policy that will govern the use of calculators in the classroom. Ten questions to consider when developing such a policy are given.

[Recommendations, Roles]

Muzeroll, Peter Arthur. Attitudes and Achievement in Mathematics in Student Choice and Non-Choice Learning Environments. (The University of Connecticut, 1975.) Dissertation Abstracts International 36A: 4233; January 1976.

One group of students was allowed to select activities from seven resource areas (one of which involved calculators) while the comparison group was taught under a non-choice option. A total of 207 seventh graders participated. Results showed no significant differences in mathematics attitude or achievement between the two groups. Overall, there was a significant decline ($p < .05$) in students' attitudes toward mathematics from the end of grade 6 through the end of grade 7 for both groups of students.

[Achievement, Attitudes, Junior high (grade 7), Research]

Myrick, Alvin G. Electronic Calculators in School Mathematics. Centroid 1: 4-6; Spring 1975. (North Carolina Council of Teachers of Mathematics.)

[Roles]

NACOME. Overview and Analysis of School Mathematics Grades K-12.

Washington: Conference Board of the Mathematical Sciences, National Advisory Committee on Mathematical Education (NACOME), November 1975.
ERIC: ED 115 512.

In the report, references to the use of calculators are made at many points, including pages 24-25, 34, 40-43, 138, 141, and 145.

[Elementary, Recommendations, Roles, Secondary]

NAEP. Hand Calculator. In Mathematics Objectives: Second Assessment.

Denver, Colorado: National Assessment of Educational Progress, 1978.
ERIC: SE 024 326.

One test booklet of approximately 25 exercises for calculators was administered at each age level tested in the second NAEP Mathematics Assessment. Students are required to use a four-function calculator after being given a minimal amount of instruction on how to calculator is used. Many of the exercises appear again in another booklet for the same age group, allowing for comparisons of performance with and without the calculator. Background information regarding extent of calculator use is also requested.

[Research (survey), Testing]

NCTM. NCTM Board Approves Policy Statement on the Use of Minicalculators in the Mathematics Classroom. NCTM Newsletter 11: 3; December 1974.

The position statement developed by the NCTM Instructional Affairs Committee on the use of calculators in the schools is reported.

[Recommendations]

NCTM. Minicalculators in Schools. Arithmetic Teacher 23: 72-74; January 1976. Mathematics Teacher 69: 92-94; January 1976.

This report from the NCTM Instructional Affairs Committee presents nine justifications for using the hand-held calculator in classrooms, with some specific examples of curricular applications.

[Activities, Recommendations, Roles]

NCTM. Position Statements: Use of Minicalculators. Mathematics Teacher 71: 468; May 1978.

The 1974 NCTM Board of Directors' position statement on calculators is reprinted.

[Recommendations]

NCTM. Minicalculator Information Resources. Reston, Virginia: National Council of Teachers of Mathematics.

This free resource list cites articles, books, newsletters, and media, plus information on calculator models appropriate for school use. It is updated at intervals.

[References, Selection]

NCTM. Mathematics Teacher: New Products, Programs, Publications.

In this monthly feature of the journal, calculators and materials for use with calculators in the classroom are frequently reviewed.

[Selection]

Nebel, Kay (Project Director). The Calculator as a Learning Aid in the Classroom. Western Springs, Illinois: District 101, Title III ESEA Calculator Project, 1977.

Booklets for grades 5 (Whole Numbers, Division, Fractions, Decimals, Measurement) and grade 6 (Enrichment) have been developed.

[Curriculum, Elementary (grades 5-6), Measurement, Mixed operations, Units]

Neill, Hugh. The Use of Electronic Calculators in the Sixth Form. County of Durham Education Committee, 1978.

(See also: Neill, H. Calculators in the Sixth Form. Department of Mathematics, University of Durham, May 1977. Field Test Version. See also: The Calculator Motivator. Education, p. 252, March 1979.)

This report consists mainly of descriptions of ways in which calculators may be used in dealing with A-level topics, with the existing curriculum. Numerous examples are provided.

[Activities, Calculus, College, Research, Secondary]

Nelson, Dennis William. Effects of Using Hand Calculators on the Attitudes and Computational Skills of Children in Grades Four Through Seven. (Arizona State University, 1976.) Dissertation Abstracts International 37A: 3382-3383; December 1976.

A total of 196 summer school students in grades 4 through 7 were placed in one of four different curricular programs: the regular mathematics program, the regular mathematics program plus calculators, a commercial calculator-involved curriculum, or a diagnosis-remediation calculator program. Findings showed that gains in basic computational skills and attitudes of students were significantly improved when students used calculators.

[Achievement, Attitudes, Elementary (grades 4-6), Junior high (grade 7), Remedial, Research]

Neufeld, K. Allen. Calculators in the Classroom. Monograph No. 5. Edmonton: Alberta Teachers' Association, 1977.

[Activities]

New, Peter J. Choosing an Electronic Calculator. Mathematics in School 6: 12-13; January 1977.

Types of power supply for calculators, physical size of calculators, functions desired, numeric range and degree of accuracy, amount of use, and display or print-out are discussed as some of the features that a consumer should consider in selecting a calculator.

[Selection]

New, Peter J. What's New in Calculators. Mathematics in School 6:
January 1977.

[Selection]

New York. The Electronic Calculator in Remedial Mathematics. In
Mathematics: Ideas for Strengthening Mathematical Skills. Albany:
State Education Department. ERIC: SE 024 566.

A brief section indicates that calculators have a role to play in
mathematics instruction, but care must be taken that the structure
of algorithms is not hidden. A set of four problems is provided
to illustrate a worthwhile use of calculators.

[Problem solving, Remedial, Roles]

New York. Flow Charts and Calculators. In General High School Mathe-
matics. Albany, New York: State Education Department, August 1978.
Pp. 58-64. ERIC: ED 161 767.

The use of calculators is encouraged, along with the use of flow
charts. Reasons for using calculators (from Suydam, 1976) are
given.

[Flow charts, Pros/cons, Secondary]

New York. Mathematics: Ideas for Strengthening Mathematics Skills.
Albany, New York: State Education Department, 1978, Pp. 33-34.
ERIC: ED 161 730.

Several suggestions and activities are given for use of calculators
in remedial mathematics.

[Activities, Recommendations, Remedial, Roles]

Nicolai, Michael B. Sum of the Integers. Mathematics Teacher 71:
271-273; April 1978.

The calculator makes it feasible for students to find the sum of
all n-digit whole numbers that may be formed from an n-digit whole
number.

[Integers]

Nichols, Warren Elmer. The Use of Electronic Calculators in a Basic
Mathematics Course for College Students. (North Texas State
University, 1975.) Dissertation Abstracts International 36A:
7919; June 1976.

No significant differences were found when achievement and attitude
of college basic mathematics students in classes using the calculator
were compared to those of students in non-calculator basic mathe-
matics classes. Among students using calculators, those having
higher aptitudes in mathematics showed significantly higher achieve-
ment and attitude scores than students having lower aptitudes.

[Achievement, Attitudes, Basic mathematics, College, Research]

NIE. Euclid Conference. Conference on Basic Mathematical Skills and Learning, October 4-6, 1975, Euclid, Ohio. Volume I: Contributed Position Papers. Volume II: Working Group Reports. National Institute of Education, 1975. ERIC: ED 125 908 and ED 125 909.

References are made to the role of the calculator in the mathematics classroom (see Vol. I, pp. 24-26, 101-104, 119, 127, 151-152, 223-224; Vol. II, pp. 17-18, 38-39) and recommendations are made for projects and research involving calculators (Vol. I, p. 159 and Vol. II, pp. 11-12).

[Recommendations, Roles]

NIE/NSF. Report of the Conference on Needed Research and Development on Hand-Held Calculators in School Mathematics. National Institute of Education and National Science Foundation, 1977. ERIC: ED 139 665.

Results of the conference, intended to provide a well-defined framework for future research and development efforts, are reported. Twenty-one recommendations covering the development of an information base, curriculum development, research and evaluation, teacher education, and dissemination are discussed.

[Recommendations, Research (needed), Roles]

Nielsen, Thomas G. and Loiacono, Ronald. Report of Evaluation Plan and Data on K-1 Materials of Elementary Mathematics Concepts with CalculatorsTM Program. Dallas: Texas Instruments Learning Center, 1977.

This is the report by two "outside evaluators" of the kindergarten and first-grade program developed by Texas Instruments,

[Elementary (grades k-1), Evaluation]

Nijenhuis, Albert and Wilf, Herbert S. Combinatorial Algorithms for Computers and Calculators. Second edition. New York: Academic Press, 1978.

[Algorithms, College]

Noll, Edward M. Learning Electronic Theory with Hand Calculators: Basic Equations and Ohm's Law. Popular Electronics 10: 43-46; July 1976.

This is the first of three installments on how to use a scientific calculator to solve basic electronics problems. Ohm's law and dc circuits; calculating the total resistance, capacitance, and inductance in series and parallel circuits; and resonance are discussed.

[College, Engineering, Scientific calculators]

Noll, Edward M. Learning Electronic Theory with Hand Calculators: Reactance, Time Constants, and AC Calculations. Popular Electronics 10: 58-59; August 1976.

In this second installment on using the hand-held calculator to learn electronics, reactance, RC time constants, and phasor calculations are covered.

[College, Engineering, Scientific calculators]

Noll, Edward M. Learning Electronic Theory with Hand Calculators: RC Coupling, Basic Amplifier Calculations, and RLC Relationships. Popular Electronics 10: 70-73; September 1976.

This is the last of a three-part series on using the hand-held calculator in electronics. Examples of calculations for resistor-capacitor couplings, amplifiers, and RLC networks are presented and explained.

[College, Engineering, Scientific calculators]

Noll, Edward M. Basic Electronics Math with a Scientific Calculator. Indianapolis: H. W. Sams & Co., 1977.

[College, Electronics, Scientific calculators]

North, Roger. Using a Hand-held Electronic Calculator. Mathematics in School 4: 22-23; March 1975.

The arithmetic needed for complex calculation using an electronic calculator is explained and exemplified. Problems involving square roots, number theory, Fibonacci numbers, and electrical resistances are solved.

[Problem solving, Roles, Secondary]

North Carolina. Calculator Inservice Kit. Prepared by Mathematics Division, North Carolina State Department of Public Instruction, 1978.

In this notebook kit are transparency masters, calculator games, calculator activity cards for grades 5 through 9, and calculator problem card decks for teachers.

[Elementary (grades 5-6), Junior high (grades 7-9), Kit, Problem solving, Teachers (in-service)]

Novus. Quiz Kid Quizbook. Sunnyvale, California: National Semiconductor Corporation, 1974.

This booklet, accompanying the Novus Quiz Kid calculator, contains nine puzzles and simple number activities.

[Activities]

Novus. Quiz Kid Funbook. Sunnyvale, California: National Semiconductor Corporation, 1974.

This booklet, accompanying the Novus Whiz Kid calculator, presents 14 calculator activities.

[Activities]

Nuffield Foundation. Desk Calculators. New York: John Wiley & Sons, Inc., 1968.

[Activities, Desk calculators]

Ockenga, Earl. Calculator Ideas for the Junior High Classroom. Arithmetic Teacher 23: 519-522; November 1976.

Activities and games for computation and estimation, measurement and geometry, functions, and problem solving and applications are described.

[Activities, Junior high]

Ockenga, Earl and Duea, Joan. Ideas. Arithmetic Teacher 25: 28-32; May 1978.

Four worksheets are given in which the calculator can be used to provide practice on estimation.

[Estimation, Worksheets]

Ockenga, Earl and Duea, Joan. Ideas. Arithmetic Teacher 27: 28-32; January 1979.

Games for addition, subtraction, multiplication, and division are presented; the objective is to provide practice in estimation.

[Elementary (grades 1-6), Estimation, Games, Junior high (grades 7-8), Mixed operations]

O'Daffer, Phares G. Calculator Challenges. Math Lab Matrix 5: 6-7; Spring 1976. (Illinois State University)

[Activities]

Offenheiser, Marilyn. U.S. Homes in on Calculators. Electronics 45: 69-71; September 25, 1972.

Challenging Japanese domination of the business calculator sales, Americans are exploiting technology, not merely exporting it. Reduced prices for U.S. calculators are upstaging cheap Japanese labor.

[Marketing]

Oglesby, Alice. A Calculator Crossword Puzzle. Calculators/Computers 1: 38-39; October 1977.

The words for this crossword puzzle are found by working computational problems on a calculator and reading the inverted display.

[Activities]

Oglesby, Mac. "Hilo," "Hurkle." Calculators/Computers 1: 42-47; May 1977.

(See also: Programming correction discussed in Calculators/Computers 1: 91; October 1977.)

Directions for two calculator games are given. One can be played on either an inexpensive or a programmable calculator, the other only on a programmable calculator. Flowcharts and programming steps are provided.

[Four-function calculators, Games, Programmable calculators]

Oglesby, Mac. Frogs. Calculators/Computers 1: 5-8; October 1977.

Rules for playing the game "Frogs" on an SR-52 programmable calculator are given. Flowcharts, a program listing, and a sample game are included.

[Flow charts, Games, Programmable calculators, Programming]

Olney, Ross and Olney, Pat. Pocket Calculator Fun and Games. New York: Franklin Watts, Inc., 1977.

[Games]

O'Loughlin, Thomas. Using Electronic Programmable Calculators (Mini-Computers) in Calculus Instruction. American Mathematical Monthly 83: 281-283; April 1976.

An experiment in which a programmable calculator was used as an instructional aid in a calculus classroom and as a laboratory device for students is described.

[Calculus, College, Desk calculators, Research]

Olson, Melfried. Using Calculators to Stimulate Conjectures and Algebraic Proofs. Mathematics Teacher 72: 288-289; April 1979.

Three examples are given that can be used to stimulate conjectures and that lend themselves to an algebraic proof. The calculator can enable students to test cases which would have been fruitless, if not impossible, without the calculator.

[Algebra]

Osborne, J. M. The Pocket Calculator in School Physics. Physics Education 9: 414-419; September 1974.

The significance of the simple type of calculator as a tool in the classroom is discussed, as well as the contribution of the more sophisticated type to the school science department.

[Physics, Roles]

Osofsky, Barbara L. Small Calculators for the Mathematician. Notices of the American Mathematical Society 23: 422-430; December 1976.

Oswald, Ruth. Hand Held Calculator Unit (Grade 6). Fairview Park, Ohio, 1978.

[Activities, Elementary (grade 6), Four-function calculators, Units]

Ounsted, John. Pocket Calculators and Recurring Decimals. Mathematics Teaching 82: 54; March 1978.

Alternatives to finding recurring decimals (in addition to those in Pallister, 1977; Turnbull et al., 1977; and Tyler, 1977) are given.

[Decimals]

Pallas, Norvin and Behr, Joyce. Calculator Puzzles, Tricks & Games. New York: Sterling Publishing Co., Inc., 1976.

Instructions are provided for puzzles, tricks, and games appropriate for children in grades 4 through 8.

[Activities, Elementary (grades 4-6), Games, Junior high (grades 7-8)]

Pallister, J. Still More on Recurring Decimals. Mathematics Teaching 80: 43; September 1977.

An alternative way to investigate recurring decimals with the calculator is given (see also Turnbull, 1977; Tyler, 1977).

[Decimals]

Palmer, Henry B. A. Minicalculators in the Classroom--What Do Teachers Think? Arithmetic Teacher 25: 27-28; April 1978.

A survey of leadership personnel in Los Angeles County is reported; although a wide range of reactions was found, on the whole teachers seemed favorable to the idea of calculators in the classroom.

[Research (survey), Teachers]

Papritan, James C., II. The Effect of Pocket Calculators Versus Paper and Pencil Procedures on Algorithm Achievement of Vocational Agriculture Students. Unpublished doctoral dissertation, The Ohio State University, 1978.

Sophomore vocational agriculture students were randomly selected from two sets of 10 schools and assigned to treatments using calculators or not using calculators for a one-week unit on introductory machine management. Significant differences in cognitive achievement and time utilization were found for the group using calculators rather than paper-and-pencil procedures. No difference in attitudes was found.

[Achievement, Attitudes, Four-function calculators, Problem solving, Research, Secondary, Vocational agriculture]

Papy, Frederique et al. Math Play Therapy CSMP Mathematics for the Intermediate Grades, Volume I. St. Louis: CEMREL, Inc., 1977.

This is the first draft of a supplementary text for the CSMP mathematics program for the intermediate grades. It describes several games and activities appropriate for use with small groups of slow learners at the third- and fourth-grade levels. Although several activities require use of the Papy Minicomputer (described in the text), many utilize a hand calculator with algebraic logic and constant feature.

[Activities, Curriculum, Elementary (grades 3-4), Games, Units]

Papy, Georges. Using a Hand Calculator to Solve the Chessboard Problem. St. Louis, Missouri: CEMREL Inc., 1975.

A method is described for finding $2^{64} - 1$ with the aid of an eight-digit calculator.

[Powers, Problem solving]

Parks, Terry E. Minicalculators: Opportunity or Dilemma? Bulletin of the Kansas Association of Teachers of Mathematics 49: 18-21; April 1975.

The phenomena which will have the most profound effect on mathematics education in the 1970s are the changeover to the metric system and the rapidly increasing use of hand calculators. Reportedly 30 to 50 percent of all secondary students in Kansas City have access to calculators, yet relatively little has been written about their use in schools. Research on the effects of such use has produced mixed results. The decision to use or not use calculators in the classroom must depend on many factors. Calculators can be used functionally as an eraser or desk, or pedagogically like textbooks and flashcards. Used in either way they will necessarily cause curricular changes; they deal in decimals, not fractions, and handle negative numbers as easily as positive. The major benefit of calculator use will be in the area of motivation.

[Roles]

Parks, Terry E. Calculator Survey, Shawnee Mission Public Schools. Shawnee Mission, Kansas, 1977.

Results of a calculator survey on availability of calculators to K-12 students and on parent and teacher opinion toward the use of calculators in the classroom is given. Data from both 1975 and 1977 are cited.

[Attitudes, Elementary (grades K-6), Research (survey), Secondary (grades 7-12)]

Pask, Gordon. Travels with a Calculator. Houston, Texas: Gulf Publishing Co., 1977.

[Activities, Games]

Peckham, Herbert D. and Weir, Maurice D. Introduction to the TI-59 Programmable Calculator. Calculators/Computers 2: 52-57; September/October 1978.

Activities designed to familiarize (calculus) students with the use of the TI-59 are presented.

[Activities, College, Programmable calculators, Programming]

Pederson, Dean A. Making Machines Count. Early Years 7: 34-35, 71; January 1977.

[Activities]

Pederson, D. O. and Sharrah, Paul C. The Calculator Race—1979 is Prime. Physics Teacher 17: 250; April 1979.

A programmable calculator was "raced" against a microcomputer.

[Programmable calculators, Selection]

Pendleton, Deedee. Calculators in the Classroom. Science News 107: 175, 181; March 15, 1975.

Both the manufacturers of electronic calculators and "progressive" educators are anxious to see a calculator in every classroom. Although opponents claim that students using them won't know how to count when the batteries die, instructors using them say calculators increase students' interest and enable them to solve more interesting problems.

[Pros/cons]

Pendleton, Deedee. Calculators in the Classroom. Creative Computing : ; January-February 1976.

The pros and cons of using a calculator in schools are discussed.

[Pros/cons]

Peters, William T. The HP-25 as a Digital Clock and Timer. Popular Electronics 11: 57-58; August 1977.

How to program an HP-25 calculator to serve as a clock/timer with display in hours, minutes, and seconds is described.

[Programmable calculators, Programming, Time]

Peterson, A. W. Calculated Class Madness. Mathematics in Michigan 14: 18-23; May 1975. (Michigan Council of Teachers of Mathematics.)

[Activities]

Peterson, Robert E. and Capoferi, Alfred. 1975-76 Fraser High School, Macomb Intermediate School District Project: Study on the Use of Hand-Held Calculators in Pre-Algebra (Grade 10), Algebra I (Grade 10), and Intermediate Algebra (Grade 11). Fraser, Michigan: Fraser Public School District, 1976.

A general project description is provided. Data, observations, and calculator activities and problems are reported for each of the mathematics groups.

[Algebra, Research, Secondary (grades 10-11)]

Philadelphia. The Mini-Calculator Project. Eye on Education 4: 8-9; Number 1, 1975. (Temple University College of Education.)

A large-scale investigation of the effects of the availability and use of the calculator on the attitudes and mathematics achievement of seventh-grade students is described.

[Achievement, Attitudes, Junior high (grade 7), Research]

Philadelphia. Teachers Approve of Mini-Calculator Use in Classrooms. Math's Alive, Volume IV, No. 10. Philadelphia, Pennsylvania: Office of Curriculum and Instruction, The School District of Philadelphia, June 1975.

Results of a questionnaire sent to all secondary mathematics teachers in Philadelphia public schools are presented and discussed.

[Attitudes, Research (survey), Secondary, Teachers]

Phillips, Bonnie D. and Storey, Dale A. Business Mathematics for Calculating Machines. New York: Macmillan, 1976.

This is "little more than an instruction manual for the Frieden, the Marchant, the Olivetti, and electronic calculators. Many of the exercises are also quite dated." (American Mathematics Monthly.)

[Business education, Desk calculators]

Phillips, R. F. Simple Gravitation Using a Programmable Pocket Calculator. Physics Education 12: 360-363; September 1977.

Described is the calculation (with a programmable calculator) of the potential of the earth's gravitational field strength and the energies of satellites in orbit around the earth.

[College, Physics, Programmable calculators, Programming]

Pitcairn, Cameron C. and Baker, Gregory L. The Rocket Game. Physics Teacher 12: 427-429; October 1974.

A program (for a programmable calculator) is provided which simulates the problems of rocket propulsion, hovering, and soft landing.

[Physics, Programmable calculators, Programming]

Pollak, Henry O. Hand-Held Calculators and Potential Redesign of the School Mathematics Curriculum. Mathematics Teacher 70: 293-296; April 1977.

The content and teaching of secondary-school mathematics in the calculator era are discussed.

[Curriculum, Roles, Secondary]

Posamentier, Alfred S. Remedial Mathematics Skill Program, School Year 1974-1975. 1975. ERIC: ED 137 478.

[Curriculum, Remedial, Secondary (grades 9-10)]

Priest, E. C. Additional Functions for Your Pocket Calculator. Popular Electronics 14: 64; October 1973.

By knowing a few simple procedures, one can make a simple four-function calculator perform many functions. Positive integral exponentials, reciprocals, and square roots are easily computed by the described methods.

[Four-function calculators, Powers, Reciprocals, Roots, Secondary]

Prigge, Glenn and Gawronski, Jane Donnelly. Calculator Activities. Big Spring, Texas: Math-Master, 1978.

Puzzles, Pattern searches, problems, and a variety of other activities are included in this book.

[Activities, Elementary]

Prigge, Glenn and Langemo, Jan. Effects of Minicalculators on the Pre- and Co-Requisite Mathematical Skills of Intermediate School Children. Grand Forks: University of North Dakota Department of Mathematics, Summer 1978.

Thirty children from grades 3-6 in a summer school mathematics enrichment program in June 1978 were given experimenter-designed instructional materials designed to allow each student to work independently at his or her own level. Treatments were randomly designed. Pre and post tests on multiplication, division, and attitudes were given, plus ten other tests during the experimental period. No significant differences were found on the three pre-post measures for students who (1) used calculators randomly in assignments or (2) were instructed that they must use calculators to complete assignments. On problems that students generally know how to work, the calculator did not seem to make much difference. However, if students knew the operation but could not carry out the mechanics of the algorithms, use of the calculator resulted in substantial mean gains.

[Achievement, Attitudes, Division, Elementary (grades 3-6), Multiplication, Research]

Prigge, Glenn and Mauland, Lyle (editors). Activities for the Minicalculator. Minot: North Dakota Council of Teachers of Mathematics, 1978.

The activities in this 100-page book developed by elementary teachers are planned to be reproducible for classroom use.

[Activities, Elementary, Worksheets]

Quadling, Douglas. A Nation of Button Pushers? Mathematics in School 4: 23; May 1975.

The use of electronic calculators in the British classroom is examined. Concerns center on the extent of use, with basic questions about use on tests, fairness to those who cannot afford them, and the danger of them becoming a "crutch."

[Pros/cons, Roles]

Quinn, Donald R. Yes or No? Calculators in the Classroom. NASSP Bulletin 60: 77-80; January, 1976.

Reasons for using or not using calculators are discussed.

[Pros/cons]

Quinn, Donald Ray. The Effect of the Usage of a Programmable Calculator upon Achievement and Attitude of Eighth and Ninth Grade Algebra Students. (Saint Louis University, 1975.) Dissertation Abstracts International 36A: 4234-4235; January 1976.

The programmable calculator was used in eighth- and ninth-grade algebra classes for evaluating algebraic expressions and for solving linear, quadratic, and systems of equations. Findings showed no significant differences in achievement when performance of students in the calculator classes was compared to performance of those in non-calculator algebra classes. However, students in the calculator classes showed less "anxiety toward mathematics" and had better "self-concept in mathematics" than students in non-calculator classes.

[Achievement, Algebra, Anxiety, Junior high (grades 8-9), Programmable calculators, Research]

Quinn, Mildred Louisa. Accounting Class Failures and Arithmetic Deficiencies. Business Education Forum 28: 30-31; March 1974.

A common cause of failure in accounting, student inability to compute mentally, could be resolved if a calculator were available to all students.

[Business education, Roles]

Quinn, Mildred Louise. Combining Business Math and Clerical Office Machines. Business Education Forum 29: 21-23; April 1975.

[Business education]

Rade, Lennart. Take a Chance with Your Calculator. Forest Grove, Oregon: Dilithium Press, 1977.

[Activities, College, Programmable calculators, Secondary]

Rade, Lennart and Kaufman, Burt A. Adventures with Your Hand Calculator. Stockholm, Sweden: Biblioteksforlaget, 1976. St. Louis, Missouri: CEMREL, Inc., 1977.

Part I of this book contains 20 problems which can be solved or investigated with a calculator. Part II provides a commentary on each of these problems. Although solutions are not always provided, the commentaries often present new situations which extend the ideas of the original problem.

[Activities, Mixed operations, Problem solving, Secondary]

Ratti, J. S. and Manougian, M. N. Introductory Calculus with Applications. Boston: Houghton-Mifflin, 1977.

Problems for calculators are included.

[Calculus, College]

Rees, Paul K.; Sparks, Fred W.; and Rees, Charles S. Intermediate Algebra (fifth edition). New York: McGraw-Hill, 1978.

An introduction to the use of calculators is included.

[Algebra, College, Secondary]

Reeves, Charles A. Planning to Use Calculators? Texas Mathematics Teacher 22: 3-4; October 1975. (Texas Council of Teachers of Mathematics.)

[Activities, Roles]

Reiland, Robert J. A Realistic Model Rocket Program for a Small Programmable Calculator. Calculators/Computers 2: 72-74; September/October 1978.

A program for the prediction of the altitude achievable by a model rocket is given.

[College, Physics, Programmable calculators, Programming]

Reubens, Arthur. Tracking Down Equation Roots. Machine Design 50: 120; August 10, 1978.

A program written for an HP-55 calculator is given.

[Programmable calculators, Programming, Roots]

Reynolds, P. 3.ICME Karlsruhe 1976. Mathematics in School 5: 35-36; November 1976.

Selected remarks by panel members concerning the future implications of computers and calculators are recorded. Four general points arising from the discussion are summarized.

[Roles]

Reys, Robert E.; Bestgen, Barbara J.; Coburn, Terrence G.; Schoen, Harold L.; Shumway, Richard J.; Wheatley, Charlotte L.; Wheatley, Grayson H.; White, Arthur L. White; (and Marcucci, Robert). Key-strokes: Calculator Activities for Young Students. Palo Alto, California: Creative Publications, Inc., 1979.

This workbook contains a variety of activities in which the calculator is integrated with mathematical instruction.

[Activities, Elementary, Worksheets]

Rhodes, Bennie. Calculator Word Games. Milford, Michigan: Mott Media, 1977.

[Games]

Riden, Chuck. Less Than Ten on a Calculator. School Science and Mathematics 75: 529-531; October 1975.

A method to check addition and subtraction in any number base less than ten, using a simple adding machine or a calculator, is given.

[Checking, Elementary, Four-function calculators, Nondecimal bases, Secondary]

Rising, Gerald R.; Krist, Betty J.; and Roesch, Carl. Using Calculators in Mathematics. National Institute of Education Contract No. 400-78-0013. Buffalo: State University of New York at Buffalo, 1978. Xerox copy.

This preliminary set of materials incorporates the use of programmable calculators in the standard mathematics curriculum in grades 11 and 12 (following the New York State syllabus). The first draft (chapters 1-8) is available for experimental use.

[Course description, Programmable calculators, Secondary (grades 11-12)]

Rising, Gerald R. The New Calculation in Education: A Research Agenda. Paper presented at a conference on needed research with calculators sponsored by the National Institute of Education, January 1979. ERIC: SE 027 683.

The role of research and the types of needed research for exploring the effects of using calculators are discussed. Specific examples of how calculator use can be integrated into learning and instruction are presented. Many issues are raised throughout the paper, many dealing with the types and quality of research.

[Curriculum, Recommendations, Research (needed), Roles]

Roberts, Dennis M. and Fabrey, Lawrence J. Impact of Prepractice, Work Set and Type of Calculator on Statistical Problem Solving. University Park: The Pennsylvania State University, 1977. Xerox copy.

[College, Problem solving, Research, Statistics]

Roberts, Dennis M. and Fabrey, Larry. Effects of Calculation Method, Amount of Prepractice and Instructional Work Set on Numerical Problem Solving. Calculators/Computers 2: 63-70; March 1978.

This study investigated the effect on computation performance of amount of prepractice and type of calculator, when students were told to work very fast versus very accurately. Sixty students in an introductory statistics course were randomly assigned to four treatments: basic machine, 2 or 5 prepractice trials; advanced machine, 2 or 5 trials. Half of each group worked under "fast" or "accurate" conditions. Amount of prepractice made no difference in number correct or in time required to work the problems. Students using the more advanced calculators needed only about half the time and had more correct answers. Time and accuracy were greater under the "accurate" condition. The advanced calculator group was significantly more efficient, as was the "fast" condition. On four of five attitude clusters, advanced calculator users were significantly more positive.

[College, Problem solving, Research, Statistics]

Roberts, Dennis and Glynn, Shawn M. Calculators and Statistical Problem Solving. Paper presented at the Northeastern Educational Research Association Meeting, October 1976. Xerox copy.

[College, Problem solving, Research, Statistics]

Roberts, Dennis M. and Glynn, Shawn M. Effects of Calculation Method and Task Difficulty on Statistical Problem Solving. Unpublished paper. The Pennsylvania State University. April 1977.

In a pilot study (October 1976), 48 college students were randomly assigned to manual (no calculator), basic, or advanced calculation conditions to work statistical problems. Calculator groups took less time and made fewer errors than the manual group. In a second study, 60 college students worked easy and hard statistical problems under one of the three calculation conditions. Results indicated that calculator usage reduced working time and errors, especially on hard statistical problems. Subjects in the calculator groups also expressed more positive attitudes about themselves and the problem solving tasks.

[College, Problem solving, Research, Statistics]

Roberts, Dennis M. and Glynn, Shawn M. A Comparison of Numerical Problem Solving Under Three Types of Calculation Conditions. Calculators/Computers 2: 71-74; January 1978.

The purpose of this study was to examine the relative magnitude of benefit that accompanies use of calculators compared to hand computation. Forty-eight students in an introductory statistics course were randomly assigned to three treatment groups: (1) Manual—all computation by hand; (2) Basic Machine—use of a four-function calculator without memory or square root key; or (3) Advanced Machines—use of calculators with either two memories or square root. They were given a test with five routine sets of data and problems involving frequency distributions. Large differences were found between either of the machine conditions and the manual condition, but very little difference was found between the two machine conditions. The machine work was more than twice as efficient as calculation by hand.

[College, Problem solving, Research, Statistics]

Roberts, Dennis M. and Glynn, Shawn M. Numerical Problem Solution as a Function of Calculation Mode and Task Difficulty. Calculators/Computers 2: 69-73; February 1978.

This is the second in a series of studies designed to test the hypothesis that calculators facilitate problem solution by saving time and increasing accuracy. Sixty students in an introductory statistics course were involved; computational tests containing both easy and difficult statistical problems were used. Students were randomly assigned to manual, basic machine, or advanced machine conditions. The calculator groups were superior on measures of number correct, time, and efficiency scores and in attitude, with the two types of calculator groups not significantly different. Task difficulty was not significant, although there was a larger difference between performance on easy and difficult problems in the hand condition than in the machine conditions.

[College, Problem solving, Research, Statistics]

Roberts, Dennis M. and Glynn, Shawn M. Teaching Introductory Statistics for Psychology: Effects of Calculators on Performance and Motivation. Perceptual and Motor Skills 48: 563-569; 1979.

Sixty college students worked both simple and complex statistical problems under one of three computational conditions: manual (no calculator), elementary calculator, and advanced calculator. Results indicated that calculator usage reduced working times and errors, especially on complex problems, and helped to preserve positive attitudes students held about themselves and the nature of their problem solving.

[College, Problem solving, Research, Statistics]

Roberts, Dennis and Lerner, Jackie. Computational Performance with Different Calculation Methods and Task Difficulties: A Repeat Investigation. Calculators/Computers 2: 74-77; April 1978.

One-hundred-two students in a beginning statistics course were randomly assigned to six conditions—use of handwork or of simple or advanced calculators with either easy or difficult problems. The difficulty of the problems did not have a significant impact on the number of problems answered correctly. Time varied with type of calculator and difficulty level. Efficiency improved as sophistication level of the calculator improved. The group using the most sophisticated calculator expressed more positive attitudes than other groups did.

[College, Problem solving, Research, Statistics]

Roberts, Dennis M.; Seaman, Dennis; and Lerner, Jackie. Maximizing Effects of Calculators: A Study Varying Calculation Procedures, Difficulty of Tasks and Working Instructions. Calculators/Computers 2: 60-62; May 1978.

The study compared the differences between "the best computational method" (a calculator with sophisticated features) with "the most tedious one" (hand work). Sixty-four students (from an introductory statistics course) were randomly assigned to calculator or hand groups. All worked one set each of easy and hard problems (on mean, variance, and correlation), and one set each of problems under directions to work as fast as possible and as accurately as possible. The number of correct answers in the calculator group was more than double that of the hand group. Easy problems were solved correctly more often than hard problems, with a considerable drop in performance on hard problems in the hand group. It took the hand group about six times longer on the average to work the problems. The calculator group was over 15 times more efficient. The work-fast and work-accurately directions had no significant effect on performance. Attitude comparisons favored the calculator group.

[College, Problem solving, Research, Statistics]

Roberts, Edward M. Fingertip Math. Dallas: Texas Instruments, 1974.

This book explains how to use a hand-held calculator effectively.

[Activities]

Roberts, H. Edward. Electronic Calculators. Indianapolis: Howard W. Sams & Co., Inc./Bobbs-Merrill, 1974.

How calculators work, rather than how to work with calculators, is the focus of this book.

[Selection]

Robinson, Ann (editor). The Hand-Held Calculator. Cedar Falls: Iowa Council of Teachers of Mathematics, 1976.

Activities appropriate for the middle school student are suggested.

[Activities, Elementary (grades 5-6), Secondary (grades 7-8), Worksheets]

Robinson, Ann (editor). High School Activities for the Calculator. Cedar Falls: Iowa Council of Teachers of Mathematics, 1977.

Calculator activities are organized under the following categories: algebra, advanced algebra, general mathematics, geometry, junior high, probability, trigonometry, and miscellaneous.

[Activities, Secondary]

Rogers, Jean B. Introducing Calculators to Your Class. Calculators/Computers 1: 57-59; October 1977.

A set of steps for introducing calculators to elementary school children is suggested.

[Activities]

Rogers, Jean B. Using Calculators for Problem Solving. Calculators/Computers 2: 19-21; March 1978.

A unit is presented which specifies how the calculator can be used for two problem-solving techniques, trial-and-correction and make a table.

[Problem solving, Units]

Rogers, Joy J. The Electronic Calculator—Another Teaching Aid? Arithmetic Teacher 23: 527-530; November 1976.

Four features of teaching aids which endure are identified and discussed, and the nature of the electronic calculator as a teaching aid is analyzed.

[Pros/cons]

Rogers, J. T. The Calculating Book: Fun and Games with Your Pocket Calculator. New York: Random House, 1975.

This book contains an anthology of games, puzzles, puns, magic tricks, and other mathematical problems or investigations.

[Activities, Games, Problem solving]

Rogers, James T. 10 Games You Can Play with a Pocket Calculator.
Science Digest 77: 42-45; May 1975.

This excerpt from The Calculating Book gives brief directions for doing number "tricks," mathematical shortcuts, and calculations which spell out words. The mathematical rationale behind the "tricks" is not explained.

[Activities]

Rogers, James T. Seven Pocket Calculator Games. Creative Computing
2: 19; January-February 1976.

Steps for seven number tricks are given, with no explanations for why the tricks work.

[Activities]

Rogers, James T. Fun and Games with Your Calculator. MATYC Journal
12: 210; Fall 1978.

This is an excerpt from Rogers' 1975 book; three problems are included.

[Activities]

Rosenblum, Arlene. Should Your Child Use a Calculator? Good House-
keeping 184: 224; February 1977.

Advantages of allowing children to use calculators in school are discussed briefly. Features to look for in selecting a calculator for children are described.

[Pros/cons, Selection]

Royce, George and Shank, James. Calculators in the Classroom?
Science Teacher 44: 23-25; October 1977.

The results of a student attitude survey among junior high school students who had been allowed to use calculators to check mathematics computations are reported. Significant preference for using calculators in the classroom was displayed.

[Attitudes, Junior high, Research (survey)]

Rudnick, Jesse. Pocket Sized Calculators Versus Seventh Grade Math Students. Philadelphia: Temple University, May 1978. Multilith copy.

Approximately 700 seventh-grade students in two schools were randomly assigned either to calculator or control groups. Each of six teachers taught two experimental and two control classes, using the regular textbook. Students were "on their own" as to how and when they used calculators; they kept logs of when and for what operations calculators were used. No significant difference in computational skills was found between groups. Attitudes of students in both groups varied little. Parental attitudes, however, changed: while 50 percent opposed the use of calculators at the outset, only 33 percent were opposed at the end. At the start, 49 percent felt

that their children would become highly dependent on the machine, while at the end this number dropped to 22 percent.

[Attitudes, Junior high (grade 7), Research]

Rudnick, Jesse A. and Krulik, Stephen. The Minicalculator: Friend or Foe? Arithmetic Teacher 23: 654-656; December 1976.

The effect of the availability and use of a calculator on seventh graders' mathematics achievement was studied. Preliminary findings on parental attitude toward the use of calculators and on student achievement are discussed.

[Achievement, Attitudes, Junior high (grade 7), Research]

Rudolph, William B. and Claassen, A. D. The Calculator Book. Boston: Houghton Mifflin, 1976.

[Activities]

Russakoff, Andrew. Calculator Calculations, Mathematics Teacher 72: 188; March 1979.

Using the calculator for graphing the relations for equations like $x^a + y^a = 5^a$ is presented.

[Algebra, Secondary]

Russell, Sheila. Calculators in the Classroom. Mathematics Teaching 78: 35-37; March 1977.

Activities are described in which the calculator is used for extending students' knowledge of place value and of basic arithmetic operations.

[Mixed operations, Place value, Roles]

Salisbury, David F. Calculators, Power Tools for Thinking. Reprint from Christian Science Monitor, 1976.

Using the calculator for solving many examples of applied problems (comparison shopping for new cars, grocery costs, financial computations, sports statistics, sewing, home energy usage, metric system, measurement problems, home fix-up, and space navigation) is explained in this booklet.

[Consumer applications]

Sandery, P. The Programmable Calculator as an Aid. South Australian Science Teachers Journal 742: 49-51; 1974.

[Programmable calculators, Science]

Satek, L. C. Calculators and Significant Figures. Journal of Chemical Education 54: 177; March 1977.

[Significant figures]

Scaife, D. B. Atomic Orbital Contours—A New Approach to an Old Problem. Journal of Chemical Education 55: 442-445; July 1978.

A novel approach to the computation of probability contours with the use of calculators is described.

[Chemistry, College]

Scandura, Alice M.; Lowerre, George F.; Veneski, Jacqueline; and Scandura, Joseph M. Using Electronic Calculators with Elementary School Children. Educational Technology 16: 14-18; August 1976.

Four K-2 studies and one for grades 3-4 considered which mathematical topics could be taught most effectively with a hand-held calculator, which new mathematical topics could be successfully introduced when using such calculators, and what implications there might be for problem solving.

[Elementary (grades k-4), Four-function calculators, Research]

Scandura, Joseph M.; Lowerre, George F.; Scandura, Alice M.; and Veneski, Jacqueline. Using Electronic Calculators with Children Ages 5-7, Four Mini-Experiments. School Science and Mathematics 78: 545-552; November 1978.

Four "mini-experiments" with small groups of children aged 5-7 are reported. Arithmetic computation with and without the calculator were compared; content of lessons is noted. General observations on motivation, independence, and other behaviors are reported, plus achievement inferences.

[Elementary (grades k-2), Four-function calculators, Research]

Schafer, Pauline; Bell, Max S.; and Crown, Warren D. Calculators in Some Fifth-Grade Classrooms: A Preliminary Look. Elementary School Journal 76: 27-31; October 1975.

Students in the calculator group scored significantly higher on calculator examples, while no differences were found on non-calculator examples between calculator and non-calculator groups.

[Elementary (grade 5), Four-function calculators, Research]

Schilt, H. Use of Calculators in Swiss Schools. Arithmetic Teacher 9: 129; March 1962.

The use of hand-cranked Curta calculators is described.

[Desk calculators, Elementary]

Schlaphoff, Carl W. CAI on a Programmable Calculator. MATYC Journal 9: 42-46; Winter 1975.

A procedure is described for presenting routine practice problems on a programmable calculator with attached teletype. The program uses a random number generator to write problems, gives feedback, and assigns grades according to the procedures outlined and flow-charted by the author.

[College, Flowcharts, Problem solving, Programmable calculators]

- Schlossberg, E. and Brockman, J. The Pocket Calculator Game Book. New York: William Morrow, 1975.
(See in German: Spiel und Spass mit dem Taschenrechner. München: Mosaik-Verlag, 1975.)
Instructions are given for games and puzzles based on card games, familiar board games, and various "practical" situations, to be played using calculators.
[Activities, Elementary (grades 4-6), Games, Junior high (grades 7-8)]
- Schlossberg, Edwin and Brockman, John. The Kid's Pocket Calculator Game Book. New York: William Morrow, 1977.
[Games]
- Schlossberg, Edwin and Brockman, John. The Pocket Calculator Game Book #2. New York: William Morrow, 1977.
Divided into games for one, two, three, or more players, this book presents 50 games, many of which sharpen players' arithmetic skills.
[Games]
- Schmalz, Rosemary. Calculator Capers. Mathematics Teacher 71: 439-442; May 1978.
An opportunity for students to discover numerical patterns is provided by three worksheets.
[Pattern searches, Worksheets]
- Schmalz, Rosemary. Calculators: What Difference Will They Make? Arithmetic Teacher 26: 46-47; December 1978.
Changes in emphasis on certain algorithms which the calculator makes feasible are discussed.
[Algorithms, Roles]
- Schmidt, Stanley A. Fourier Analysis and Synthesis with a Pocket Calculator. American Journal of Physics 45: 79-82; January 1977.
Two programs for performing Fourier analysis and synthesis with a Hewlett-Packard 25 calculator are described.
[College, Programmable calculators, Programming, Science]
- Schmitt, H. Rechenfertigkeit und elektronischer Taschenrechner in der Hauptschule. Wadgassen, 1976.
[Roles, Secondary]
- Schnur, James O. and Lang, Jerry W. Just Pushing Buttons or Learning? —A Case for Minicalculators. Arithmetic Teacher 23: 559-562; November 1976.
A study of the effect of the use of calculators on student computational ability is reported. Results showed that the treatment groups using calculators gained significantly more whole number computational

ability than control groups not using the calculator. Sex of student and calculator usage interaction was not significant, nor was the interaction between ethnic/economic background and gain in computational ability.

[Achievement, Elementary (grades 4-6), Junior high (grades 7-9), Research]

Schoen, Harold L. Calculators in Mathematics: How Should They Be Used? Paper presented at AERA Annual Meeting, April 1979. Xerox copy.

Specific examples of calculator-aided mathematics learning activities appropriate for children in grades 2 through 6 (which evolved from the Calculators in Elementary School Mathematics Project, funded by NSF) are presented.

[Activities, Elementary (grades 2-6), Worksheets]

Schott, A. F. Adventure in Arithmetic. Educational Screen 34: 65-67; 1955.

A study with students in grades 4 through 9 is reported; the groups using calculators achieved higher than groups not using calculators.

[Achievement, Desk calculators, Elementary (grades 4-6), Junior high (grades 7-9), Research]

Schultz, James E. How Calculators Give Rise to a New Need for Skills in Algebra. School Science and Mathematics 78: 131-134; February 1978.

Illustrations are given of how doing certain algebraic manipulations prior to doing calculations can eliminate unnecessary storage of data, reduce the number of steps required to obtain an answer, and avoid data overflow.

[Algebra]

Schultz, James E. Using a Calculator to Do Arithmetic in Bases Other than Ten. Arithmetic Teacher 26: 25-27; September 1978.

Many examples are provided in this presentation of using a calculator to perform operations in non-decimal bases.

[Nondecimal bases]

Schultz, James E. and Waits, Bert K. A New Look at Some Old Problems in Light of the Hand Calculator. Two-Year College Mathematics Journal 10: 20-27; January 1979.

The calculator is used to solve equations which may be difficult or impossible to solve by standard methods. Problems involving ladders, car loan payments, and the hungry goat are discussed.

[College, Problem solving]

Schwob, P. R. How to Use Pocket Calculators. New York: Petrocelli/Charter, 1976.

[Activities]

Scott, Douglas E. Finding Roots with a Four-Function Calculator.
Calculators/Computers 2: 77-81; January 1978.

The "repeat" capability of most four-function calculators is used in an algorithm to find any integral root of any number.

[Four-function calculators, Roots]

Scott, Douglas E. What Day of the Week...? Calculators/Computers
2: 26-29; November-December 1978.

An algorithm for determining the day of the week for any date is given for calculators (a BASIC program for computers is also included).

[Time]

Seymour, M. D. and Fernando, Q. Effect of Ionic Strength on Equilibrium Constants: The Use of a Pre-programmed or Programmable Pocket Calculator in the Laboratory. Journal of Chemical Education 54: 225-227; April 1977.

[Chemistry, College, Programmable calculators]

Seymour, Thomas J. Games Calculators Play! Rockford, Illinois: Seymour Publications, 1975.

[Games]

Shapiro, Donald. How To Add Functions to Simple Hand Calculators. Popular Electronics 8: 38; September 1975.

Instructions for modifying the calculator are provided.

[Building]

Sharp Electronics. Mathematics Using Electronic Calculators. Paramus, New Jersey: Sharp Electronics Corp., 1975.

[Activities]

Sharp Electronics. Pilot Use of Sharp Calculators and Math Programmed Materials in an Elementary School Remedial Math Program. Garden Grove (California) Unified School District, November 1971 to May 1972.

Results are described on a pilot program in which calculators were used with remedial mathematics students in grades 4, 5, and 6.

[Elementary (grades 4-6), Four-function calculators, Remedial, Research (pilot study)]

Sharp, J. Norman C. The Calculator Workbox. Don Mills, Ontario: Addison-Wesley Publishers, 1977.

[Activities, Junior high (grades 7-8), Kit]

Sharron, Marge and Links, Dee. Start Your Motors, Levels A, B, C, and D. Concord, California: Aardvark Media Inc., 1975.

[Activities]

Shaw, Bob. Equipment for the Mathematics Room. Mathematics in School 2: 30-31; November 1973.

Among other materials, eight permanently fixed but readily available calculators are suggested.

[Selection]

Shea, James Francis. The Effects on Achievement and Attitude Among Fourth Grade Students Using Calculator Flow-Charting Instruction vs. Conventional Instruction in Arithmetic. (New York University, 1973.) Dissertation Abstracts International 34A: 7499; June 1974.

The group having calculator instruction had significantly higher scores than a group not using calculators on computation but not other tests or an attitude measure.

[Achievement, Attitudes, Desk calculators, Elementary (grade 4), Research]

Shearer, Edmund C. Applications of a Programmable Calculator in a Freshman Laboratory. Journal of College Science Teaching 5: 244-245; March 1976.

The use of a programmable calculator for student experiments, grading of laboratory reports, and assigning accuracy and precision scores is described.

[College, Programmable calculators, Science]

Shell Centre. Mathematical Education Review 1976-77. Nottingham, England: Shell Centre for Mathematical Education, University of Nottingham, 1977.

This report on various projects underway at the Shell Centre includes one in which the possible points at which electronic calculators can contribute to the primary school mathematics curriculum are being explored. Worksheets, games and activities are being developed.

[Elementary, Roles]

Shin, Joseph. A Survey on the Attitude of Schoolchildren Towards the Use of Calculators in Schools. Calculators/Computers 2: 39-41; November-December 1978.

A questionnaire given to four classes (n=152) of fourth formers in a Hong Kong middle school is presented. More than 77 percent of the children had some experience using calculators; 60 percent of them or their families owned a calculator. Advanced calculators were preferred. Over 76 percent thought that calculators should be used on tests. Other findings are also given, and the value of calculators use is discussed.

[Attitudes, Elementary, Pros/cons, Research (survey)]

Shirey, John Reginald. The Effects of Computer-Augmented Instruction on Students' Achievement and Attitudes. (University of Oregon, 1976.) Dissertation Abstracts International 37A: 3386-3387; December 1976.

Tenth, eleventh, and twelfth graders in consumer and business mathematics classes were randomly assigned to receive computer-augmented instruction or a low-cost alternative using tables and calculators to complete inquiry exercises. The instructional unit covered nine days. Results showed that the calculator group did significantly more inquiry beyond the minimum required than did the computer group.

[Business mathematics, Consumer applications, Research, Secondary (grades 10-12)]

Shuch, Milton Leonard. The Use of Calculators Versus Hand Computations in Teaching Business Arithmetic and the Effects on the Critical Thinking Ability of Community College Students. (New York University, 1975.) Dissertation Abstracts International 36A: 4299; January 1976.

Two classes of community college business mathematics students used calculators in the classroom, while two other business mathematics classes at the same school followed the same curriculum without using calculators. There were no significant differences between groups on standardized tests of arithmetic achievement, mathematical reasoning, and critical thinking abilities.

[Business mathematics, College, Research]

Shumway, Richard J. Hand Calculators: Where Do You Stand? Arithmetic Teacher 23: 569-572; November 1976.

Arguments for and against the use of hand-held calculators in school mathematics are presented.

[Pros/cons]

Shumway, Richard J. Can Young Children Safely Use Calculators? A Five State Study Offers Some Answers. February 1979. Xerox copy.

This brief report cites data and some findings from a five-state, year-long study designed to investigate how children can use calculators in grades 2-6.

[Elementary (grades 2-6), Research]

Shumway, Richard J.; Wheatley, Grayson H.; White, Arthur L.; Coburn, Terrence G.; Reys, Robert E.; and Schoen, Harold L. Initial Impact of Calculators in Elementary School Mathematics. February 1979. Xerox copy.

The findings from the five-state, year-long study investigating how children can use calculators in grades 2-6 are reported. The data indicated no significant differences in achievement between groups. Many specific suggestions for curricular applications of calculators were found.

[Elementary (grades 2-6), Research]

Sidran, Miriam. Computing the Balmer Wavelengths with a Hand Calculator. Physics Teacher 15: 423-434; October 1977.

A problem concerning the computation of hydrogen spectral line wavelengths, appropriate for computations with calculators having eight significant digits, is outlined for a general physics class.

[College, Physics]

Sieber, H.; Fischer, O.; and Ebeling, F. Taschenrechner im Unterricht. Klett Stuttgart, 1978.

[Curriculum]

Simons, S. What Can Be Done with a Simple Hand Calculator. American Journal of Physics 10: 1007; October 1977.

Procedures for evaluating $\sum_{n=0}^N (a_n/n!)x^n$, $\log a^x$, and $a^{1/n}$ using a four-function calculator are given.

[Four-function calculators, Logarithms, Reciprocals, Secondary]

Sinha, N. K. Impact of Electronic Pocket Calculator on Electrical-Engineering Education. IEEE Transactions on Education 20: 6; 1977.

[Engineering, Roles]

Sippl, Charles J. Calculator Users Guide and Dictionary. Champaign, Illinois: Matrix Publishers, Inc., 1976.

Along with a 7000-term dictionary relating to calculators, comprehensive sections cover what is available today (1976) in programmable calculators and how to use most units in the \$50 to \$3000 price range.

[Programmable calculators, Selection]

Sippl, Charles J. Programmable Calculators. Champaign, Illinois: Matrix Publishers, Inc., 1976.

This reference covers the use of programmable calculators and provides a description of the capabilities of those available in 1976.

[Programmable calculators, Selection]

Sippl, Charles J. and Kidd, David A. Microcomputer Dictionary and Guide. Champaign, Illinois: Matrix Publishers, Inc., 1975.

Definitions of programmable calculator terms are included.

[Programmable calculators]

Sippl, Charles J. and Sippl, Roger J. Programmable Calculators: How to Use Them. Champaign, Illinois: Matrix Publishers, Inc., 1978.

[Programmable calculators]

Skoll, Pearl. Coping with the Calculator. Northridge, California: Pearl Skoll, 1975.

Activities for use with calculators are presented.

[Activities]

Sloyer, Clifford W., Jr. and Tingey, Henry B. Binomial Probabilities and the Pocket Calculator. Math Sciences Roundtable 1: 27-31; 1979.

Use of the calculator in computing probabilities for the binomial is discussed, with specific examples and problems.

[College, Probability, Programmable calculators, Programming]

Smeets, P. M. Teaching Retarded Adults Monetary Skills Using an Experimental Calculator. Behavioral Engineering 5: 51; 1978.

Suggestions are given for helping retarded adults learn to use the calculator.

[Consumer applications, Handicapped (retarded), Post-secondary]

Smith, Buddy Lee. A Study of the Effectiveness of the Use of the Electronic Calculators in Teaching the Simplex Method to Business and Economics Majors. (North Texas State University, 1977.) Dissertation Abstracts International 38A: 3986; January 1978.

Attitudes toward mathematics and achievement in mathematics in groups which used or did not use calculators in the classroom were studied. Sixty-nine students in two sections of a one-semester business and economics course were randomly selected. Little difference in achievement or attitude was found between users and non-users, sexes, or aptitude levels.

[Achievement, Attitudes, Business education, College, Research]

Smith, Clinton L. Computing in Secondary Physics at Armdale, W.A. Australian Science Teachers Journal 22: 33-40; May 1976.

A secondary school physics course utilizing an electronic programmable calculator and computer is described. Calculation techniques and functions, programming techniques, and simulation of physical systems are detailed. A summary of student responses to the program is included.

[Course description, Physics, Programmable calculators, Secondary]

Smith, Gerald R. Repeating Decimals. Calculators/Computers 2: 57-61; March 1978.

Determining repeating decimals is examined in this article, with 17ths, 19ths, 23rds, 31sts, and 41sts suggested for exploration.

[Decimals]

Smith, Jon M. Financial Analysis & Business Decisions on the Pocket Calculator. New York: John Wiley & Sons, 1976.

[Business, Finance]

Smith, Jon M. Scientific Analysis on the Pocket Calculator. New York: John Wiley & Sons, 1975. Second edition, 1977.

Suggestions for advanced uses of the calculator are presented.

[College]

Smith, J. R. Desk Calculators. Brooklyn Heights, New York: Beekman Publishers, Inc., 1973.

[Desk calculators]

Smith, Susan. Calculating Order. Mathematics Teacher 71: 519-522; September 1978.

Worksheets provide a calculator experience developing and reinforcing the concept of order of operations, for students in grades 7-10.

[Mixed operations, Secondary (grades 7-10), Worksheets]

SMP. Calculators in Schools. London, England: School Mathematics Project, 1977.

This is a report of an investigation carried out by SMP during 1976-77 in seven schools following their syllabuses. Certain uses of the calculator (e.g., checking, motivation) were confirmed.

[Research, Roles]

Snadden, R. B. and Runquist, O. Simulated Experiments. Education in Chemistry 12: 75, 77; May 1975.

An experiment is presented in which a programmable calculator is employed as a data-generating system for simulated laboratory experiments. The example used is a simulated conductimetric titration of an aqueous solution of HCl with an aqueous solution of NaOH.

[Chemistry, College, Programmable calculators]

Snover, Stephen L. and Spikell, Mark A. The Role of Programmable Calculators and Computers in Mathematical Proofs. Mathematics Teacher 71: 745-750; December 1978.

Since numerous possibilities can be examined in a relatively short period of time, calculators and computers are powerful data-gathering instruments. How they can be used in proofs is explored with a simple problem from number theory.

[College, Programmable calculators, Proofs, Secondary]

Snover, Stephen L. and Spikell, Mark A. Because of Programmable Calculators, Why Avoid These Problems Any Longer? January 1979. ERIC: SE 026 857.

Several examples of types of problems accessible to students who have programmable calculators are given. Finding limits, evaluating and calculating infinite series, computing variable length products, searching for data, and developing proofs are among the examples.

[College, Programmable calculators]

Snover, Stephen L. and Spikell, Mark A. Programmable Calculators Facilitate Simple Solutions to Mathematical Problems. January 1979. ERIC: SE 026 858.

Problems which can be used with calculators are presented.

[Problem solving, Programmable calculators]

Snover, Stephen L. and Spikell, Mark A. Using Programmable Calculators to Evaluate Complicated Formulas. January 1979. ERIC: SE 026 859.

An area of a triangle problem, in which the calculator does the tedious work, is explored.

[Problem solving, Programmable calculators]

Snover, Stephen L. and Spikell, Mark A. $x = \frac{1}{x} + 1$, A Programmable Calculator Activity. January 1979. ERIC: SE 026 860.

One non-standard activity which students can explore with a calculator is given, with questions, analysis, and related activities.

[Activities, Programmable calculators]

Snover, Stephen L. and Spikell, Mark A. Generally, How Do You Solve Equations? Mathematics Teacher 72: 326-336; May 1979.

Iterative techniques to solve various types of difficult problems are presented, with specific examples, flowcharts, and programs.

[Flow charts, Iteration, Numerical analysis, Programming, Programmable calculators, Secondary]

Snover, Stephen L. and Spikell, Mark A. How to Program Your Programmable Calculator. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1979.

Procedures for programming calculators are explained in detail, with many specific examples for two types of calculator logic.

[Calculator logic, College, Programmable calculators, Secondary]

Sosebee, Jackson B., Jr. and Walsh, Lola Mae. Pocket Calculators and Test Scores in Introductory Chemistry. Journal of College Science Teaching 4: 324; May 1975.

Presented is a brief description of a study done to assess the impact of the use of calculators during examinations, showing that the use of the calculators did play a major role in chemistry grade determination.

[Chemistry, College, Research, Testing]

Spencer, JoAnn Nora. Using the Hand-held Calculator in Intermediate Grade Arithmetic Instruction. (Lehigh University, 1974.) Dissertation Abstracts International 35A: 7048-7049; May 1975.

For an eight-week study, 40 fifth graders and 44 sixth graders were randomly assigned to either a calculator group or a non-calculator group. Both groups worked with computation sheets prepared by the experimenter. The calculator group scored significantly higher than the non-calculator group on the reasoning

test in grade 5 and on the computation test and total arithmetic test in grade 6.

[Achievement, Elementary (grades 5-6), Research]

Spero, Samuel W. Computers and Calculators: A Strategy for Combined Usage in Trigonometry. ERIC: ED 156 208. 1977.

The described instructional strategy was used to incorporate both the computer and the hand calculator into trigonometry courses at an Ohio community college. The computer was used to generate different problem sets for individual students and, at the same time, solution sets for the instructor. The students were required to use calculators to complete individually assigned problem sets. Increased motivation and achievement with respect to trigonometry objectives, and acquisition of calculator skills, resulted.

[College, Trigonometry]

Spero, Samuel W. Calculators and Computers: Graphical Addition. Calculators/Computers 2: 87-90; September/October 1978.

The computer is used to generate a different problem set for each student; students then use calculators to solve these problems; finally, the computer generates the solution set for each student's problems. Graphical addition problems are used as examples.

[Problem solving]

Stanford, Charles. How to Convert a "Four Banger" for Stopwatch Functions. Popular Electronics 11: 56-57; August 1977.

Described is how to convert a four-function calculator to a stopwatch by adding a three-IC circuit.

[Building]

Stearns, Howard F. Add 4 Functions to Novus 850. Radio-Electronics 47: 54-55; December 1976.

Instructions are given for adding four switches (memory store, memory recall, constant, and percent) to the regular four-function Novus 850 keyboard.

[Building]

Stein, Philip. Small World. Computer Decisions 8: 14; May 1976.

Computer-like functions which can now be done by electronic calculators are described, and areas where calculators are deficient are listed.

[Roles]

Steinbrocker, D. Calcu/Letter, Volume 1. New York: Pyramid Publications, 1975.

[Activities]

Stephen, J. Sydney and Trueman, Robert W. Calcu-Math. Buffalo, New York: Scholar's Choice, 1977. Stratford, Ontario: Scholar's Choice Limited, 1977.

This kit is a set of activity cards and worksheets designed to apply basic skills and stress estimation and problem solving while using a simple four-function calculator.

[Activities, Four-function calculators, Kit, Worksheets]

Stephens, Max. Developing Classroom Materials Utilizing Minicalculators. Australian Mathematics Teacher 34: 129-140; October 1978.

Suggestions for materials using minicalculators to cultivate higher-order skills are given.

[Activities, Roles]

Steuer, Michael. Banking on Your Calculator. MATYC Journal 12: 193-194; Fall 1978.

Using a calculator to compound interest is presented.

[Consumer applications]

Stocks, Sister Tina Marie. The Development of an Instructional System Which Incorporates the Use of an Electric Desk Calculator as an Aid to Teaching the Concept of Long Division to Educable Mentally Retarded Adolescents. (Columbia University, 1972.) Dissertation Abstracts International 33A: 1049-1050; September 1972.

All students demonstrated an improvement in scores between pre- and posttest; however, no tests of significance were made. A positive change in attitude was also found.

[Achievement, Attitudes, Desk calculators, Handicapped (retarded), Research]

Stolovich, Harold. A Pocket Calculator Never Loses Patience. Audiovisual Instruction 21: 19-20; December 1976.

Seven advantages of using a calculator in teaching mathematics to handicapped learners are identified. The use of the calculator as a tool for discovery, for drill and practice, and for motivation is discussed.

[Pros/cons]

Stover, Donald W. Teaching and Using Algorithms in the Classroom. FSC Journal of Mathematics Education, No. 12, 1977. (Frostburg State College, Maryland.)

The focus is on using the calculator for secondary school mathematics instruction, and includes a list of 45 "ways to enrich mathematics instruction with calculators."

[Activities, Secondary]

Stultz, Lowell. Electronic Calculators in the Classroom. Arithmetic Teacher 22: 135-138; February 1975.

(See also: Readers' Dialogue, Arithmetic Teacher 22: 658-660; December 1975, for two responses to this article.)

Several applications of calculators at various elementary grade levels are suggested, with some punch/display sequences illustrated.

[Activities]

Sullivan, John J. Using Hand-Held Calculators in Sixth-grade Classes. Arithmetic Teacher 23: 551-552; November 1976.

Classroom use of calculators is described, including a brief discussion of ways in which the use of the calculator can enrich, supplement, support, and motivate the regular program.

[Activities, Elementary (grade 6)]

Summers, M. K. Programmable Calculators as an Aid in Physics Teaching. Physics Education 13: 246-250; May 1978.

How to implement numerical integration on a pocket calculator to solve two kinds of differential equations is described.

[College, Physics, Programmable calculators]

Summers, M. K. Use of a Programmable Pocket Calculator in A-Level Physics Courses. School Science Review 60: 316-325; December 1978.

[Physics, Programmable calculators, Secondary]

Sutherlin, William Norman. The Pocket Calculator: Its Effect on the Acquisition of Decimal Estimation Skills at Intermediate Grade Levels. (University of Oregon, 1976.) Dissertation Abstracts International 37A: 5663; March 1977.

As they studied a unit on decimal operations and on estimation techniques, four fifth and sixth grade classes used calculators while four other classes did not. No significant differences in estimation skills were found.

[Decimals, Elementary (grades 5-6), Estimation, Research]

Sutz, Sherilyn P. Calculator Center. Bulletin 49: 20-31; April 1975. (Kansas Association of Teachers of Mathematics.)

[Activities]

Suydam, Marilyn N. Electronic Hand Calculators: The Implications for Pre-College Education. Final Report, Grant No. EPP 75-16157, National Science Foundation, February 1976. ERIC: ED 127 205 (full report); ED 127 206 (50-page form).

Research is reported which was conducted to provide the NSF with information on the existing range of beliefs and opinions about the impact of the calculator on pre-college education. A literature

search and several surveys of groups involved in calculator manufacture or in education were conducted. In addition, four position papers by prominent educators were obtained. The body of the report presents summaries of information collected relevant to availability of calculators, arguments for and against their use in schools, ways in which they are now used in schools, and research findings. Five recommendations related to study of and preparation for implementation of calculator use are made. Appendices to the report present an annotated list of references, the detailed findings of the surveys, and the position papers: Immerzeel et al. discuss plausible instances in which to use calculators; Pollak proposes criteria for redesigning the curriculum; Weaver makes suggestions for needed research; and Usiskin and Bell provide some perspectives on curriculum revision.

[Curriculum, Pros/cons, Research (survey)]

Suydam, Marilyn N. Using Calculators: How--Not Should. Math Lab Matrix 1-3; Spring 1976. (Illinois State University.)

Results of the NSF project "Electronic Hand Calculators: The Implications for Pre-College Education" are summarized. Frequently given reasons for and against the use of calculators are listed, along with ten recommendations for classroom use of calculators.

[Pros/cons]

Suydam, Marilyn N. Calculate Your Position. FSC Journal of Mathematics Education, No. 12, 1977. (Frostburg State College, Maryland.)

[Pros/cons]

Suydam, Marilyn N. (editor). Investigations with Calculators: Abstracts and Critical Analyses of Research. Columbus, Ohio: Calculator Information Center, January 1979. ERIC: SE 027 581.

This document contains expanded abstracts of 36 research reports in which the use of calculators was explored, with comments on each report by the abstractor.

[Research (review)]

Suydam, Marilyn N.; Cummins, Kenneth; Gibney, Thomas; Hill, Johnny; Meiring, Steven; and Pikaart, Len. Ohio Regional Conferences on Mathematics Education: Final Report. (NSF-funded project.) Columbus: The Ohio State University, 1978. ERIC: SE

The report includes materials and problems developed for the conferences, designed for elementary school teachers and supervisors.

[Activities, Four-function calculators, Problem solving]

Swartz, Clifford. Editorial: Ban the Calculator. Physics Teacher 14: 134; March 1976.

The author argues that the failure of calculators to show significant numbers only predicates a re-evaluation of the types and uses of electronic calculators in schools.

[Pros/cons]

Szetela, Walter. Calculators and the Teaching of Ratios in Grade 7. October 1978. Xerox copy.

Specially designed lessons to expedite student involvement in measuring activities were used by the investigator in the teaching of ratio skills and concepts to 39 students in grade 7 who were randomly assigned to a class with calculator-based instruction or to a class not using calculators. There were eleven days of instruction by the investigator and four days of pre- and posttesting. On two tests on ratio skills, concepts, and problems and on a test of attitude toward learning ratios, there were no significant differences. On a test with unfamiliar ratio problems where the calculator class was allowed to use calculators, the calculator class scored significantly higher than the non-calculator class (.02).

[Junior high (grade 7), Ratios, Research]

Szetela, Walter. A Study of Ratio Concepts, Skills, and Problem Solving Using Calculators in Grade 7. 1978. Xerox copy.

This study was concerned with the use or non-use of calculators by 39 students in grade 7 who used specially designed lessons to increase involvement in measuring activities. There were 11 days of instruction. On two tests on ratio skills, concepts, and problems and on a test of attitude toward learning ratios, no significant differences were found. On a test with unfamiliar ratio problems on which the calculator class used calculators, they scored significantly higher than the non-calculator class.

[Junior high (grade 7), Ratios, Research]

Szetela, Walter. Hand-Held Calculators and the Learning of Trigonometric Ratios. Journal for Research in Mathematics Education 10: 111-118; March 1979.

The investigator and the regular teacher used specially designed materials for teaching trigonometric ratios to 131 students in grades 9 and 10 randomly assigned to groups using calculator-based instruction or not using calculators for 13 days. Students built their own short trigonometric tables using measurements of specially constructed right triangles. On a quiz one week before the final achievement test, the calculator groups scored significantly higher than the non-calculator groups (.02). There were no significant differences on the final achievement test or in attitude toward learning ratios.

[Research, Secondary (grades 9-10), Trigonometry]

Szetela, Walter and Campbell, Robert. Measurement and Hand-held Calculators in the Teaching of Trigonometric Ratios. Vector 19: 27-31; June 1978. (British Columbia Association of Mathematics Teachers.)

(See also: Szetela, Walter and Campbell, Robert. Using Calculators to Teach Trigonometry. Alberta Teachers Association Mathematics Council 18: 6-10; November 1978.)

This article reports on a research study with 131 students in grades 9 and 10 who were randomly assigned to groups using or not using calculators for instruction on trigonometric ratios for 13 days. Calculator groups scored significantly higher than non-calculator groups on a test one week before the final test, but there were no significant differences on the final test.

Tashjian, Richard Haig. A New Technique for Evaluating Consumer Preferences with Application to Calculator Product Characteristics. (New York University, Graduate School of Business Administration, 1977.) Dissertation Abstracts International 38B: 1789; October 1977.

A model was developed to estimate the probabilities of purchase associated with various products within a category. In addition to providing information on which products are preferred, the technique provides knowledge of several components of product preference including attribute importance, interaction, and sensitivity. The technique was piloted causing the product category of hand-held calculators.

[Marketing, Research]

Taylor, Ross. NACOME: Implications for Teaching K-12. Mathematics Teacher 69: 458-463; October 1976.

Instructional and logistical problems related to having calculators in the classroom are discussed.

[Elementary, Roles, Secondary]

Teitelbaum, Eli. Calculators for Classroom Use? Arithmetic Teacher 26: 18-20; November 1978.

Letting instruction focus on problem solving rather than computation alone is the point of this article. How calculators can be used to advantage is described through four illustrations, with comments on checking and on cheating.

[Problem solving, Roles]

Tenny, Ralph. How to Fully Debounce Low-Cost Keyboards. Popular Electronics 11: 51-52; January 1977.

Keyboards for home-brew calculators often lack two important features --contact debouncing (without it, each key can produce multiple signals) and key encoding (encoding makes it possible to determine just which key has been operated). A circuit diagram to overcome these problems is presented.

[Building]

Texas Instruments. Basic Family Math. Dallas: Texas Instruments Learning Center, 1976.

[Consumer applications]

Texas Instruments. Fun with Math Facts: 18 Learning Games and Activities Using the Little Professor. Dallas: Texas Instruments, Inc., 1976.

[Activities, Games, Preprogrammed devices]

Texas Instruments. The Great International Math on Keys Book. Dallas: Texas Instruments Learning Center, 1976.

Sections of this book cover the basic keys on a scientific calculator; how to use the calculator for converting units of measure; using the calculator for practical everyday problems, algebra, business and finance, trigonometry, probability and statistics, and physics and chemistry; and puzzles and games for the calculator.

[Activities, Scientific calculators, Secondary]

Texas Instruments. Learning Basic Concepts with Limited-Function ABLE Calculators (K-1). Dallas: Texas Instruments, Inc., 1976.

[Activities, Elementary (grades k-1)]

Texas Instruments. Student Math Kit. Dallas: Texas Instruments, Inc., 1976.

[Activities, Kit]

Texas Instruments. Understanding Calculator Math. Dallas: Texas Instruments, Inc., 1976.

This guide contains basic information, formulas, facts, and mathematical tools to "unleash the real power of your calculator."

[Activities]

Texas Instruments. Calculating Better Decisions. Dallas: Texas Instruments Learning Center, 1977.

[Activities]

Texas Instruments. Fundamental Programming Using Handheld Calculators. Dallas: Texas Instruments, Inc., 1977.

Developed by the University of Denver Mathematics Laboratory, this course is a step-by-step package for teaching programming using handheld programmable calculators.

[Programmable calculators, Programming]

Texas Instruments. Games: Calculator Squares and Check Out. Dallas: Texas Instruments, Inc., 1977.

[Games]

Texas Instruments. Making Tracks into Programming: A Step-by-Step Learning Guide to the Power, Ease and Fun of Using Your TI Programmable 57. Dallas: Texas Instruments, Inc., 1977.

[Programmable calculators, Programming]

Texas Instruments. Mathematics Learning with Calculators: Elementary Mathematics Concepts with Calculators. Dallas: Texas Instruments, Inc., 1977.

Supplementary materials in kit form are intended to teach certain mathematics concepts using the calculator. Recognition, counting, more-than-less-than, and plus-minus are included.

[Activities, Elementary, Kit, Units]

Texas Instruments. Mathematics Learning with Calculators: Fundamental Mathematics. Dallas: Texas Instruments, Inc., 1977.

Supplementary materials in kit form are intended to teach certain mathematics concepts using the calculator. Signed numbers, algebraic logic, functions, graphing, statistics, and probability are included.

[Activities, Kit, Secondary, Units]

Texas Instruments. Mathematics Learning with Calculators: Introductory Algebra. Dallas: Texas Instruments, Inc., 1977.

Supplementary materials in kit form are intended to teach certain mathematics concepts using the calculator. Evaluating expressions, solving equations, signed numbers, formulas, and algebraic principles are included.

[Activities, Algebra, Kit, Secondary, Units]

Texas Instruments. Calculator Analysis for Business and Finance. New York: McGraw-Hill, 1978.

Specific procedures to use in business and financial applications are presented.

[Business, Finance]

Thiagarajan, Sivasailam. Calculators Are "In" and Cheap: Here Are Four Games You Can Play Using the Least Expensive. Simulation/Gaming/News 2: 10-13; January 1975.

The four suggested games may be appropriate for older students.

[Games]

Thiagarajan, Sivasailam. 4 Games for 4-Function Calculators. Creative Computing 3: 126-128; September-October 1977.

Four games which can be played by both children and adults are given, for use with a four-function calculator.

[Four-function calculators, Games]

Thiagarajan, Sivasailam and Stolvitch, Harold D. Games with the Pocket Calculator. Menlo Park, California: Dymax, 1976.

Twenty-four games to be played with a calculator are described. Information includes the number of players, the approximate time required, the skills involved, the chance factor, and the game sequence.

[Elementary (grades 4-6), Games, Junior high (grades 7-9)]

Thompson, Linda L. Appendix on Calculators. In Consumer Mathematics. Encino, California: Glencoe Publishing Co., 1978.

[Activities, Consumer applications]

Thornton, Carol A. Measure Up Via Calculator Skills. Math Lab Matrix 5: 5; Spring 1976. (Illinois State University.)

"Talking calculators" for the blind are described.

[Handicapped (blind), Selection (features)]

Tobin, Alexander and Eib, George J., Jr. Buying a Calculator. New Jersey Mathematics Teacher 35: 20-22; Winter 1978.

[Selection]

Toole, Betty A. Evaluation of the Effectiveness of Calculator Assisted Curriculum and Instruction in Ninth Grade General Mathematics Classes. Paper prepared for AERA Meeting, 1979.

The use of a supplementary calculator-assisted program, used one day a week in six different junior high schools (N = 400) for ninth-grade general mathematics was compared with non-use of calculators in that course. In the six-month period between pre- and posttesting, the experimental group gained 8 months more on the total test than the control group did. On subtests, the experimental group gained more than the control group in computation (7 months), concepts (5 months), and applications (1 year).

[Achievement, General mathematics, Research, Secondary (grade 9)]

Toth, Frank S., Jr. Calculator Experiments for Junior High. Calculators/Computers 2: 69-73; April 1978.

Three experiments used with seventh graders are presented: finding quotient and remainder, listing 10 non-zero multiples of a given number, and stating which of the numbers 2 to 20 are factors of a given number.

[Division, Junior high (grade 7), Multiplication]

Toth, Frank S., Jr. Calculator Experiments for Junior High (continued). Calculators/Computers 2: 69-73; May 1978.

This article, a continuation of one in the April 1978 issue, presents one experiment for determining the GCF and one for determining the LCM, using calculators.

[Division, Junior high (grade 7), Multiplication]

Toth, James. Understand Electronic Math. Science Digest 84: 69-74; August 1978.

Base two, calculator logic, adding, and other operations are discussed.

[Calculator logic, Nondecimal numeration, Mixed operations]

Triggs, E. The Value of a Desk Calculating Machine in Primary School Mathematics. Educational Research 9: 71-73; November 1966.

Two groups of students, matched for ability, were found to make significant gains whether or not they used the calculator.

[Desk calculators, Elementary (grade 3), Research]

Troutman, Andria P. and Lichtenberg, Betty K. Calculators in the Classroom: Concepts and Computations. In Mathematics: A Good Beginning--Strategies for Teaching Children. Monterey, California: Brooks/Cole Publishing Co., 1977. Pp. 474-504.

[Activities, Roles]

Tufte, Edward R. Sophisticated Electronic Pocket Calculators: Theory and Practice for the Consumer and User. Creative Computing 3: 34-35; May-June 1977.

Nine principles to help the consumer and user of sophisticated pocket calculators are identified.

[Consumer applications, Post-secondary]

Turnbull, Ann and others. Still More on Recurring Decimals. Mathematics Teaching 80: 42-43; September 1977.

Using the calculator to find recurring decimals is described (see also Pallister, 1977; Tyler, 1977).

[Decimals]

Tweddale, R. Bruce. Difficult Budgetary Decisions: A Desk-Top Calculator Model to Facilitate Executive Decisions. Paper presented at the Annual Forum of the Association for Institutional Research, May 1976. ERIC: ED 126 846.

A desk-top programmable calculator is used as part of a budgetary decision model developed to aid executive officers in arriving at tentative decisions on enrollment, tuition rates, increased compensation, and level of staffing. Advantages of using the calculator are discussed.

[Desk calculators]

Tyler, Ken. Still More on Recurring Decimals. Mathematics Teaching 80: 43; September 1977.

Another child's use of the calculator in explorations with recurring decimals is given (see also Pallister, 1977; Turnbull et al., 1977).

[Decimals]

Tyler, Tommy N. Build This Electronic Stopwatch. Radio-Electronics 46: 43-45; November 1975.

Directions are given for modifying a calculator with a simple circuit which adds an elapsed time measurement feature to the basic calculator circuit. Schematic diagrams are provided.

[Building, Time]

Tyler, Tommy N. Theft Alarm for Handheld Calculators. Popular Electronics 9: 42; March 1976.

Directions are given for constructing an audible alarm that sounds off when a calculator is unplugged from its charger.

[Building]

Usiskin, Zalman. Are Calculators a Crutch? Mathematics Teacher 71: 412-413; May 1978.

That a crutch is a bad thing is questioned; use of the calculator as a useful crutch is illustrated,

[Roles]

Usiskin, Zalman P. The Future of Fractions. Arithmetic Teacher 27: 18-20; January 1979.

The effect of calculator use on the teaching of fractions is among the factors discussed.

[Fractions]

Utterback, Allen C. Discovery via Calculators. MATYC Journal 9: 22-29; Spring 1975.

Uses of calculators and computers in the college classroom are described, a philosophy about their use is discussed, and several problems (especially amenable to use of a computer with plotting facility) are presented.

[College, Problem solving, Roles]

Vail, Roy. Programmable Calculators in Biology Classes. American Biology Teacher 36: 496-498; November 1974.

Some uses of calculators in biology classes are described; for example, charting exponential population curves, evolution by natural selection, and random genetic drift.

[Activities, Biology, Programmable calculators, Secondary]

Valery, N. Big Computers vs. Pocket Calculators (in French). La Recherche 7: 1088; 1976.

[Selection]

Van Atta, Frank. Calculators in the Classroom. Arithmetic Teacher 14: 650-651; December 1967.

Many problems cannot be done by the pupil alone, but can be handled by the pupil-plus-computer combination. Two such problems involve exponents and the Pythagorean theorem. The facility to do many computations enables students to get a better feel for rational and irrational numbers and for the definition of a logarithm.

[Activities, Desk calculators, Exponents, Geometry]

Vannatta, Glen D. The Maximum from Your Minicalculator. Carmel, Indiana: Vancom Publications, 1976.

Problems and other activities using calculators are provided.

[Activities]

Vaughn, Larry Richard. A Problem of the Effects on Hand-Held Calculators and a Specially Designed Curriculum on Attitude Toward Mathematics, Achievement in Mathematics, and Retention of Mathematical Skills. (University of Houston, 1976.) Dissertation Abstracts International 37A: 4938-4939; February 1977.

Four ninth-grade general mathematics classes used calculators as they studied decimals and percents for eight weeks in a specially-designed curriculum, while four other classes received traditional instruction with no calculators. Results showed that the calculator group scored significantly higher than the no-calculator group on an achievement test, but no differences between groups were found with respect to attitude or retention of mathematical skills.

[Achievement, Attitudes, Decimals, General mathematics, Percent, Research, Secondary (grade 9)]

Vervoort, Gerardus and Mason, Dale. Calculator Activities for the Classroom and Teacher's Resource Book. Toronto: Copp-Clark Publishing Co., 1977.

A three-part series of ditto masters in which activities facilitate the use of calculators in mathematics. The series familiarizes students with the calculator as well as its use in problem solving. The teacher's guide provides a rationale.

[Activities, Problem solving, Worksheets]

Vieules, Claudette. Des calculatrices pour les mathematiques. Le Monde de l'Education : 52-53; May 1979.

[Roles]

Vincent, William John. Elementary Statistics in Physical Education. Springfield, Illinois: Charles C. Thomas, 1976. ERIC: ED 131 066.

This statistics text includes a review of the four basic mathematics operations, square roots, and algebraic equations, and points out how the calculator can be used to assist the statistics student.

[College, Mixed operations, Physical education, Roots, Statistics]

Vine, James. Boggle: Calculator Word/Number Games. Los Angeles: Price/Stern/Sloan Publishers, Inc., 1975.

This book contains a collection of 101 jokes, five games for two or more players, and a dictionary of words with their corresponding numbers.

[Activities, Elementary (grades 4-6), Games, Secondary (grades 7-12)]

Vine, James. Fun and Games with Your Electronic Calculator. England: Babani Press, 1978.

[Activities, Games]

Vitale, Marie (editor). The Hand Calculator as a Problem Solving Device. St. Louis: Missouri Council of Teachers of Mathematics,

This document contains 20 articles on different ways a calculator can be used in a classroom.

[Activities, Problem solving]

Wagner, Sue S. Fun with Repeating Decimals. Mathematics Teacher 72: 209-212; March 1979.

The calculator is suggested as an aid in determining repeating decimals.

[Decimals]

Wahl, M. Stoessel. Simpson's Rule for Volume and the Hand Held Calculator. Calculators/Computers 1: 23-29; October 1977.

Simpson's rule for calculating volume is discussed and applied to finding the volume of several solids, with four student worksheets provided. The calculator is mentioned as a computational aid.

[Measurement]

Waits, Bert K. Using Hand-Held Calculator Computations to Develop the Concepts of Compound and Continuous Growth and to Illustrate Properties of Exponents. Ohio Journal of School Mathematics 1: 8-15; June 1977.

Several examples are discussed which secondary school algebra students (beginning to advanced levels) can explore with the use of the calculator.

[Algebra, Exponents, Secondary]

Waits, Bert K. Using a Calculator to Find Rotational Roots. Mathematics Teacher 71: 418-419; May 1978.

A method is given for approximating the n th root of any positive number with a four-function calculator with square root key and repeat multiplication capability.

[Four-function calculators, Roots]

Waits, Bert K. Classroom Applications of the Inexpensive Hand-Held Calculator. Two-Year College Mathematics Journal 9: 162-166; June 1978.

A calculator is used to explore several topics suitable for beginning college students, particularly students in developmental or beginning algebra courses. Compound interest, work with exponents, and limits are included in the examples cited.

[Algebra, College]

Wajeel, Abdullah. The Effect of a Program of Meaningful and Relevant Mathematics on the Achievement of the Ninth Grade General Mathematics Student. (Wayne State University, 1976.) Dissertation Abstracts International 37A: 2801-2802; November 1976.

The group of ninth-grade general mathematics students using an investigator-developed unit plus calculators for 15 weeks scored significantly higher ($p < .05$) on a standardized computation test than the group using only the developed unit, but there were no significant differences in attitudes.

[Achievement, Attitudes, General mathematics, Research, Secondary (grade 9)]

Walton, Stephen. Electronic Mini-Marvels: Big Performance in Tiny Packages. Popular Mechanics 150: 93-95, 210-212; October 1978.

Over a dozen electronic devices are described, including several calculators.

[Selection]

Ward, Dennis Elliott. The Effect of the Electronic Calculator on Problem-Solving Achievement and Attitudes Toward Mathematics of General Mathematics Students. (University of Southern California, 1978.) Dissertation Abstracts International 39A: 4038; January 1979.

In the first semester of 1977-78, 92 general mathematics students were randomly assigned to two experimental classes (using calculators) and two control classes (not using calculators). No significant differences in problem-solving achievement or attitudes were found; no gender effect was found. Better readers tended to score higher on problem solving both with and without calculators.

[Achievement, Attitudes, Gender, General mathematics, Problem solving, Research, Secondary (grade 9)]

Wasson, Ruth Ann. The Medium Is the Message...Or, There Is A Message in the Medium. Journal of Business Education 48: 69-70; November 1972.

Experience shows that students are accepting the use of calculators because it saves them time and provides more realistic experience related to business practice.

[Business education, Roles, Secondary]

Watson, F. R. Using a Calculator to Investigate Patterns. Spectrum 16: 24-28; October 1978.

[Pattern searches]

Watson, F. R. The Use of Electronic Calculators in Public Examinations. Spectrum 16: 31-32; October 1978.

[Testing]

Wavrik, John J. Finding the Klingon in Your Calculator. Calculators/Computers 2: 29-33; January 1978.

(See also: Wavrik, John J. Comments and Teacher's Notes and Answers. Calculators/Computers 2: 74-76; February 1978.)

(See also: Wavrik, John J. Shooting the Klingon in Your Calculator. Calculators/Computers 2: 62-64, 92; September/October 1978.)

A calculator program for finding a Klingon spaceship is given in the first article, with answers and comments provided in the second. The third article gives a program for the HP-25 calculator, to extend the first activity.

[Activities, Programmable calculators, Programming]

Wavrik, John J. The Case for Programmable Calculators. Calculators/Computers 2: 63; April 1978.

Advantages of the calculator over the computer for certain uses are discussed.

[Pros/cons]

Wavrik, John J. Programmable Calculators for Elementary School Students. Calculators/Computers 2: 44-47; September/October 1978.

Activities for students in grades 4-6 who show exceptional interest in mathematics are given in this first in a series of articles. The basic operations are programmed for the HP-25 calculator.

[Activities, Elementary (grades 4-6), Programmable calculators, Programming]

Wavrik, John J. A Short Presentation in "Computer Literacy" Using Programmable Calculators. Calculators/Computers 2: 9-11; November-December 1978.

This article outlines a one-lesson, computer literacy presentation for grades 5 and 6 using the HP-25 programmable calculator. Following a ten-minute introduction in which nine points are cited, students are given experience entering and running programs.

[Elementary (grades 5-6), Programmable calculators, Units]

Wavrik, John J. Programmable Calculators for Elementary Schools. Calculators/Computers 2: 53-55; November-December 1978.

A lesson on simple programming for students in grades 4-6 is presented, with several programs included.

[Elementary (grades 4-6), Programmable calculators, Programming, Units]

Weaver, J. F. Calculator-influenced Explorations in School Mathematics: Number Sentences and Sentential Transformations I, II. Project Paper 76-1. Madison: Wisconsin Research and Development Center for Cognitive Learning, January 1976. ERIC: ED 123 088.

Explorations involving the use of mini electronic calculators in connection with mathematics instruction were conducted with two fifth-grade classes, two second-grade classes, and three third-grade classes. Limited empirical data suggest that pupils

encounter no consequential problems with the mechanics of using simple four-function, algebraic-logic calculators in routine contexts, and that pupils likely will elect not to use calculators in situations where their use is unnecessary or of no particular advantage. While elementary-school mathematics programs usually emphasize binary operations, project explorations have moved increasingly toward content interpretations in terms of unary operations.

[Elementary (grades 2, 3, 5), Four-function calculators, Mixed operations, Research]

Weaver, J. F. Calculator-influenced Explorations in School Mathematics: A Further Investigation of Third-grade Pupils' Performance on Open Addition and Subtraction Sentences. Project Paper 76-3. Madison: Research and Development Center for Cognitive Learning, University of Wisconsin, April 1976. ERIC: ED 123 089

Limited systematic instruction was provided for two third-grade classes on a calculator-assisted approach to solving selected types of simple open addition and subtraction sentences involving three-place whole-number addends, moving from a guess-and-test procedure to more direct and efficient sentential transformations. Pupils exhibited a relatively high level of computational accuracy in their use of calculators (94%) but substantially lower levels of proficiency in providing mathematically correct solutions for "taught" and related "untaught" open-sentence types (ranging from 66 percent to 23 percent). Serious questions are raised regarding the appropriateness for young children of certain instructional approaches to the solution of simple open addition and subtraction sentences.

[Addition, Elementary (grade 3), Four-function calculators, Research, Subtraction]

Weaver, J. F. A Monadic Module Alias a Unary Unit. Project Paper 77-5. Madison: Wisconsin Research and Development Center for Cognitive Learning, University of Wisconsin-Madison, December 1977. ERIC: ED 161 670.

(See also: Weaver, J. F. A Monadic Module Alias a Unary Unit. Calculators/Computers 2: 29-36; April 1978.)

This module is excerpted from material prepared for ongoing calculator explorations with a class of accelerated seventh-grade students. Greater attention is given to unary or monadic operations. Relationships and properties to be identified, suggestions for the teacher, calculator algorithms, and record sheets are provided.

[Activities, Junior high (grade 7), Mixed operations, Units]

Weaver, J. F. Some Monadic/Dyadic Combos. Project Paper 77-6. Madison, Wisconsin: Wisconsin Research and Development Center for Cognitive Learning, December 1977. ERIC: ED 161 671.

(See also: Weaver, J. F. Some Monadic/Dyadic Combos. Calculators/Computers 2: 79-83; May 1978.)

This module is an extension of Project Paper 77-5 (and the article in the April issue of Calculators/Computers). It presents materials to extend students' understanding of algebraic operations with the use of calculators. Reference sheets, record sheets, and directions are included to aid students in focusing on monadic/dyadic operations.

[Activities, Junior high (grade 7), Mixed operations, Units]

Weaver, J. F. Calculators and Unary Operations. Project Paper 77-7. Madison: Wisconsin Research and Development Center for Cognitive Learning, University of Wisconsin-Madison, December 1977. ERIC: ED 161 672.

A rationale is given for the consideration of unary operations which can be facilitated by using calculators. Suggestions and illustrations of some ways this can be accomplished at the pre-algebra level are given.

[Activities, Roles]

Weaver, J. F. Calculators and Polynomial Evaluation. Madison: Wisconsin Research and Development Center for Individualized Schooling, The University of Wisconsin, July 1978. ERIC: ED 156 475.

The intent of this paper is to suggest and illustrate how hand-held calculators, especially nonprogrammable ones with limited data-storage capacity, can be used to advantage by students in one particular aspect of work with polynomial functions. The basic mathematical background upon which calculator application is built is summarized. Along with one calculator algorithm for polynomial evaluation that is relatively independent of calculator type, eight other algorithms that illustrate a variety of calculator types, characteristics, and features are given.

[Algebra, Algorithms]

Weaver, Peter. Tips for Buying a Pocket Calculator. Creative Computing 2: 17; January-February 1976.

Keyboard, number display, batteries, logic systems, and warranties are briefly discussed.

[Selection]

Webb, Nigel. Calculators and Computers: Educational Advantages and Dangers, Mathematics in School 5: 8-9; November 1976.

Classroom use of computers is briefly discussed. The role of hand-held calculators in the mathematics classroom is analyzed in general, and questions about the effect of calculators on student skills are raised.

[Elementary, Pros/cons, Secondary]

Wehner, Carl. Pocket Calculators in the Classroom. ICTM Journal 4: 22-25; Fall 1975. (Iowa Council of Teachers of Mathematics.)

[Activities]

Weiss, Iris R. Report of the 1977 National Survey of Science, Mathematics, and Social Studies Education. Final Report, National Science Foundation Contract No. C7619848. Research Triangle Park, North Carolina: Research Triangle Institute, Center for Educational Research and Evaluation, March 1978.

A national survey conducted for the National Science Foundation included questions about the extent of use of calculators in schools. For four grade ranges, the percentage of schools having calculators was: K-3, 28 percent; 4-6, 36 percent; 7-9, 49 percent; 10-12, 77 percent. Rural schools are as likely as suburban schools to have calculators, and both are significantly more likely to have them than schools in small cities or urban areas. The percentage of mathematics classes using calculators increased with grade level: K-3, 6 percent; 4-6, 14 percent; 7-9, 30 percent; 10-12, 48 percent. Most K-3 teachers indicated that calculators are not needed; in 4-6, 44 percent indicated they were not needed, while 39 percent needed them but did not have them; for 7-9, the comparable percentages were 42 percent and 28 percent; for 10-12, 33 percent and 18 percent.

[Elementary, Research (survey), Secondary]

Weldert, R. W. Programmable Pocket Electronic Calculators in the Classroom. Journal of Chemical Education 54: 628; October 1977.

The use of calculators in grading and in laboratory exercises is noted.

[Chemistry, Roles, Secondary, Testing]

Werner, Marijane. Effects of the Metric System and Hand-Held Calculators on the Sequencing of Concepts in an Elementary Mathematics Program. Texas Mathematics Teacher : 8-10; March 1978.

[Measurement]

Werner, Sr. Marijane. The Hand-Held Calculator and its Impact on Mathematics Curricula. Ohio Journal of School Mathematics 2: 2-7; August 1978.

Statements from other reviews on the potential uses of calculators are presented.

[Roles]

Whatham, Don. Consumer Arithmetic Elective. Australian Mathematics Teacher 33: 204-210; October-December 1977.

An elective course aimed at giving tenth-grade students some experience with practical arithmetic problems is outlined. The two-week course is designed primarily for students who will be leaving at the end of the year and includes topics such as calculators, among others.

[Consumer applications, Problem solving, Secondary (grade 10), Units]

Wheatley, Charlotte L. The Effect of Calculator Use on the Problem Solving Strategies of Elementary School Pupils. In Research Reporting Sessions, NCTM 57th Annual Meeting. Columbus, Ohio: ERIC/SMEAC. March 1979. Pp. 25-27.

Fifty fifth graders were involved in this study; 25 were from classes that had used calculators for three months prior to the study, the other 25 were randomly selected from two classes with no previous in-class calculator experience. Each student responded to five selected problems during 40-minute sessions which were tape-recorded, transcribed, and coded. The coding data were tallied to obtain frequencies of strategy use and performance scores, which were analyzed using chi square and t-tests. The two groups did not differ significantly on the range of processes used, time to solution, or performance.

[Elementary (grade 5), Problem solving, Research]

Wheatley, Grayson H. Calculators in the Classroom: A Proposal for Curricular Change. Paper presented at AERA Annual Meeting, April 1979. Xerox copy.

The role that calculators can play in mathematics instruction is discussed, with specific suggestions for curricular changes which seem needed, to shift from a computation-oriented curriculum to one encouraging the development of other mathematical skills and ideas.

[Curriculum, Elementary, Recommendations, Roles]

Whitaker, William Howard. A Study of Change in Achievement, Interest, and Attitudinal Variates Accompanying the Use of Electronic Calculators in a First Grade Mathematics Curriculum. (University of Southern California, 1977.) Dissertation Abstracts International 38A: 97-98; July 1977.

The 30-day study examined the effect of calculator use with first graders upon achievement, attitudes, and interests related to mathematics. Each group completed daily worksheets, with one group checking their results on a calculator and the other group relying upon their teachers to check results. Findings indicated that students using calculators were aided in non-timed computation and in solution to verbal problems, but they displayed smaller gains in mathematics conceptualization. No differences were found for the variables of timed computation, total achievement gain, or attitude gain.

[Achievement, Attitudes, Elementary (grade 1), Research]

Wilderman, Ann. Math Skills for Survival in the Real World. Teacher 94: 68-70; February 1977.

Six mathematics units for middle and upper elementary grades are described: banking, transportation, taxes, budgeting, shopping, and pricing and advertising. For each unit, mathematical skills and practical applications are identified, vocabulary is listed,

and a series of student learning activities, some using hand calculators, is suggested.

[Consumer applications, Elementary, Secondary, Units]

Williams, David E. The Effect of the Use of the Mini-Calculator and an Associated Curriculum Supplement on Computational Skills and Attitudes Toward Arithmetic of Ninth Grade Non-College Bound Students. (Temple University, 1979.) Dissertation Abstracts International 39A: 6610-6611; May 1979.

This year-long study was conducted in five junior high schools in Philadelphia, with three teachers each teaching one class using calculators with the regular general mathematics curriculum, one class using the regular curriculum with calculators and supplementary calculator materials, and a comparison class not using calculators. Calculators were not used on the pre- or posttest (California Achievement Test). Analysis of covariance and t-tests of correlated means were applied. No significant differences were found in computational skill, while attitude differences favored the calculator groups.

[Achievement, Attitudes, General mathematics, Research, Secondary (grade 9)]

Williams, David and Tobin, Alexander. Philadelphia Minicalculator Program. Mathematics Teacher 71: 471-472; May 1978.

Results from a survey of 415 secondary teachers are briefly summarized. Guidelines were developed and a booklet for teachers prepared. The effect of using calculators and the curriculum supplement has been studied in five schools.

[Attitudes, Research (survey), Secondary, Teachers]

Williams, S. Irene and Jones, Chancey O. A Survey of the Use of Hand-Held Calculators in Advanced Placement Calculus Courses. Princeton, New Jersey: Educational Testing Service, 1979.

The questionnaire was sent to mathematics department chairpersons at the 2402 secondary schools that had five or more students taking an Advanced Placement examination in May 1977; returns were received from 1547 schools (64.4 percent), with 1403 scorable. About 89 percent indicated that they permitted some use of calculators in calculus courses. Slightly more than 10 percent had modified their courses to include special techniques particularly suited to the use of the calculator. In only 20 percent of the schools are calculators supplied by the school districts. An overwhelming majority think that student performance (on AP examinations) would not be significantly affected if calculator use was permitted.

[Calculus, Research (survey), Secondary, Teachers, Testing]

Willson, William Wynne. Using Square Roots. Mathematics in School 5: 23-24; November 1976.

Techniques are described to enable the user of a comparatively simple calculator to perform calculations of cube roots, nth roots,

trigonometric functions, logarithms, exponentials, and inverse trigonometric functions.

[Roots, Secondary, Trigonometry]

Willson, William Wynne. Fractions by Calculator. Mathematics in School 7: 18-20; May 1978.

Described is a procedure for working with fractions on any calculator, involving the reciprocal to state the answer as a fraction.

[Fractions, Reciprocals]

Willson, William Wynne. An Exploration with a Calculator. Mathematics Teaching 7: 54-55; September 1978.

Repeatedly taking a square root and then mapping results leads to natural logarithms.

[Logarithms, Roots]

Wilson, Art Wendell. The Effects of the Hand-Held Calculator Upon Achievement Test Scores of Elementary School Mathematics Students. (University of Montana, 1978.) Dissertation Abstracts International 39A: 2116; October 1978.

In three cities over a five-month period, fifth- and sixth-grade experimental classes, with teachers who had prior experience using calculators, were compared with classes denied use of calculators. Multiple analysis of variance of pre-posttest data indicated no significant differences in computation, concepts, applications, or teacher-made test scores. In two instances, males scored higher than females.

[Achievement, Elementary (grades 5-6), Gender, Research]

Wilson, Larry E. and Funderburk, Tim. Build an Automatic Telephone Dialer. Radio-Electronics 47: 48-51; November 1976.

A method for converting an ordinary calculator into an automatic telephone dialer is described. (If the calculator has a memory, a telephone number can be stored as well.) Schematic diagrams and parts list are included.

[Building]

Winkelmann, Bernard. Taschenrechner und Fachdidaktik: Einige Strategische Perspektiven. Presentation at ICMI Seminar on Calculators in School Teaching in Luxembourg, 29 May-3 June 1978. To be published in Zentralblatt für Didaktik der Mathematik, vol. 10, no. 3, 1978.

[Roles]

Wolfe, D. B. Natural Frequencies and Mode Shapes of Multi-Degrees of Freedom Systems on a Programmable Calculator. R.C.A. Reviews 39: 604; 1978.

[College, Programmable calculators, Statistics]

Wohlfort, Frank et al. Azimuth. San Francisco, California: Monroe, 1972.

[Activities]

Woodburn, Douglas. Can You Predict the Repetend? Mathematics Teacher 69: 675-678; December 1976.

Worksheets are provided for an activity involving the use of the calculator in discovering patterns when a number is divided by 9, 99, and 999.

[Pattern searches, Secondary, Worksheets]

Wynands, A. Ergebnisse einer Schüler- und Lehrerbefragung über "Elektronische Taschenrechner (ETR) in der Schule." Zentralblatt für Didaktik der Mathematik 10: no. 1, 1978.

[Roles]

Wynands, A. and Wynands, U. Elektronische Taschenrechner in der Schule. Vieweg Braunschweig, 1978.

[Roles]

Yarbrough, L. D. The Keyboard Game. Creative Computing 2: 20-21; January-February 1976.

A two-person game to be played on a pocket calculator is described and the winning strategy discussed.

[Games]

Yates, Daniel S. Coping with Calculators in the Classroom. Curriculum Review 16: 207-209; August 1977.

This is the first of a two-part article; it considers the pros and cons of the use of calculators in the classroom, attempting to differentiate between the facts and assumptions about the problem. Important questions for research are identified.

[Pros/cons]

Yates, Daniel S. Coping with Calculators. Curriculum Review 16: 280-283; October 1977.

This is the second of a two-part article on the controversy over the use of calculators in the classroom. The author points out the possible effective uses for the calculator and suggests guidelines for those who wish to incorporate it into their classroom approaches.

[Roles]

Yee, Jose. The Problem Corner. Calculators/Computers 2: 86; September/October 1978.

An exploratory activity for finding roots of positive rational numbers is presented.

[Roots]

Young, Patrick. Readin', Writin'--And Calculatin'? American Way
11: 49-51; February 1978.

[Pros/cons]

Yvon, Bernard R. and Downing, Davis A. Attitudes Toward Calculator
Usage in Schools: A Survey of Parents and Teachers. School Science
and Mathematics 78: 410-416; May-June 1978.

Two-hundred-fifty parents and teachers of grades K-9 replied to a 12-item questionnaire about the use of calculators. They were increasingly more accepting of calculator use as grade level (3-6, 7-8, 9-12) increased, with teachers significantly more favorable than parents at the two lower levels. Both groups were moderately negative about the use of calculators for homework and about whether skills with calculators will be essential to future success. They were accepting of the use of calculators for enrichment, motivation, and games. While moderately negative replies were given about the use of calculator to replace paper-and-pencil skills, they were very accepting of the use of calculators along with paper-and-pencil computation.

[Attitudes, Elementary, Research (survey), Secondary]

Zepp, Raymond Andrew. Reasoning Patterns and Computation on Proportions Problems, and Their Interaction with the Use of Pocket Calculators in Ninth Grade and College. (The Ohio State University, 1975.) Dissertation Abstracts International 36A: 5181; February 1976.

One hundred seventy ninth graders and 198 college freshmen were classified as having high, middle, or low ability in solving proportions. Half the students in each ability group were given calculators to use while working on a programmed unit in linear interpolation, while the rest of the students could only use paper and pencil for their computations. No significant differences were found between performances of students using calculators compared to those not using calculators, nor was there any significant interaction of use of calculators with ability to solve proportions. The hypothesis that students could understand a proportional train of thought better if the barrier of computation were removed was not borne out.

[Achievement, College, Ratios, Research, Secondary (grade 9)]

Zimmermann, Mark. Random Numbers and Pocket Calculators. Calculators/Computers 2: 42-43; November-December 1978.

A procedure for generating random numbers with an HP-55 programmable calculator is presented.

[College, Programmable calculators, Programming]

Zwas, Gideon and Breuer, Shlomo. Computational Mathematics Tel Aviv, Israel: University Publishing Projects Ltd., Tel Aviv University, 1975.

This book was written for use in an undergraduate computing course which uses an electronic computer. It is divided into two parts of six chapters each. The first part assumes no knowledge of calculus,

but the second part uses calculus to extend and to generalize the materials in the first part. Topics include compound interest and the number e , equation solving, computation of areas and numerical integration, approximating , solutions to linear systems, limits, Newton-Raphson iterations, and approximations to polynomials and functions.

[College, Course description]

Activity: Calculator Conversations. New Zealand Mathematics Magazine 15: 67; September 1978.

[Activities]

An Impression of a Seminar on Calculators in Schools. Mathematics in School 5: 13-14; May 1976.

The pros and cons of using calculators in the arithmetic classroom were discussed in an English seminar for teachers.

[Pros/cons]

Apparatus: Calculators. Mathematics Teaching 79: 26-27; June 1977.

Regulations of several examining boards concerning the use of calculators in mathematics examinations are given. Reviews of three articles concerning calculators are given.

[Recommendations, Testing]

Basic Mathematics Machine Calculator Course. Windsor Public Schools, Connecticut, 1969. ERIC: ED 069 469.

This series of four text-workbooks was designed for tenth-grade mathematics students who have exhibited lack of problem-solving skills. Electric desk calculators are to be used with the text. In the first five chapters of the series, students learn how to use the machine while reviewing basic operations with whole numbers, decimals, fractions, and percents. The rest of the chapters present word problems in simple consumer mathematics, business activities, installment buying, banking, stocks and bonds, insurance, taxes, and utilities. A chapter on the use of formulas is included.

[Consumer applications, Desk calculators, General mathematics, Problem solving, Secondary (grade 10), Workbooks]

Calculated Boom. Newsweek 80: 84; October 2, 1972.

The increasing popularity of electronic calculators is reported.

[Marketing]

Calculated Warfare. Time 100: 95; October 30, 1972.

A status report on calculators is given, with the price war noted.

[Marketing]

Calculation or Computation? Is That the Question? Teacher 92: 52; March 1975.

The role of the calculator in schools is discussed.
[Pros/cons]

Calculator. Parma, Ohio: Parma City School District, no date, ERIC: ED 160 870.

Five activities are presented in this student workbook on using the calculator. Problems are given on multiplying, dividing, percentages, polygons, fractions and decimals, and square roots.

[Activities, Mixed operations, Problem solving, Secondary, Worksheets]

Calculator Buyer's Guide 1978-1979, Dallas, Texas: Personal Computer Products, Inc., 1978.

This is a catalog of calculators for business and industry.
[Business, Selection]

Calculator Games for Kids. Racine, Wisconsin: Golden Press, 1977.

[Activities, Games]

The Calculator Information Center. Calculators/Computers 2: 34-35; November-December 1978.

References from Calculator Information Center bulletins on instruction are listed.

[References (selected)]

Calculator Lib Newsletter (Gene J. Hegedus, editor). Oxnard, California: Technological Developments.

Information on calculators, plus a variety of calculator techniques and activities are included.

[Activities, Selection]

A Calculator Loser Seeks a Winning Formula. Business Week, pp. 93-94; June 14, 1976.

The return of the Victor Comptometer Corporation to the low-priced calculator market, after its losses in the 1960s, is described. Present-day organization, marketing, and management decisions are discussed.

[Marketing]

Calculator. Owning a Small Business. Parma, Ohio: Parma City School District, no date. ERIC: ED 160 869.

Seven activities are presented in this student workbook designed for an exploration of small business ownership and the use of the calculator in this career. Simulated situations are included.

[Activities, Business, Secondary]

Calculator Programs. Sky and Telescope 54: 292; October 1977.
55: 102; February 1978.
55: 301; April 1978.

Selected programs of astronomical interest that have been written for calculators are noted. Topic and source are indicated.

[Astronomy, College]

A Calculator to Fit the Pocket. Business Week, pp. 28-29; April 18, 1970.

The development of one of the first pocket-sized calculators is described.

[Selection]

A Calculator War at the Top of the Line. Business Week, pp. 19-20; July 19, 1976.

The price wars among Texas Instruments, National Semiconductor, Rockwell, and Hewlett-Packard for their scientific calculators are described.

[Marketing, Scientific calculators]

Calculators. Business Education Forum 33: 28-31; January 1979.

Various types of calculators available from calculator manufacturers are described briefly.

[Selection]

Calculators. In Consumer Guide 1975 Consumer Buying Guide. New York: New American Library, Signet Edition, 1975. Pp. 340-343.

Ratings for various types of calculators are presented.

[Selection]

Calculators All Around. Mosaic 7: 22-27; November/December 1976.

The impact of hand-held calculators on education is discussed, and areas for future research are identified.

[Roles]

Calculators and Computers in the Elementary School. Two-credit-hour Computer Science Course, University of Oregon, Eugene, Oregon.

This is a course description of a two quarter-hour computer science course designed for elementary in-service teachers. An overview of the course, an overview of each lesson, goals for each lesson, and assignments for each lesson are included.

[Computers, Course description, Elementary, Teachers (in-service)]

Calculators/Computers: The First Three Issues in Book Form. Menlo Park, California: Addison-Wesley, 1978.

[Activities]

Calculators (Editorial). New Zealand Mathematics Magazine 15:
May 1978.

[Recommendations, Roles]

Calculators for Advanced Pupils. Spectrum 16: 30-31; October 1978.
[Selection]

Calculators in the Classroom. Time 105: 88; January 6, 1975.

An overview of some initial work with calculators in the classroom is presented. Successes have been reported in computational efficiency and motivation. Problems include fear of dependency, unfair advantage, and machine-security factors.

[Pros/cons, Roles]

Calculators in the Classroom. Anaheim, California: Rockwell International, 1976.

This report on a symposium concerning the potential of calculators as teaching aids in grades 6 through 9 contains synopses of the comments of panelists and of the question-and-answer session that followed.

[Elementary (grade 6), Junior high (grades 7-9), Roles]

Calculators in the Schools: Report of the Investigation 1976-1977
School Mathematics Project. Mathematics in School 7: 32; March 1978.

[Research, Roles]

Calculators in Secondary Schools: Guidelines. Education Department
of South Australia, December 1978.

[Recommendations, Secondary]

Calculators Plus Classrooms Equal Positive Profits. Consumer Electronics News, February 1975.

The status of calculators is discussed and conclusions of manufacturers and retailers presented.

[Marketing]

Calculators, Portable Computers--Personal Problem-Solvers. Machine Design 49: 118; No. 4, 1977.

[Selection]

Calculators Remotivate High School Students Towards Math. Educational Equipment and Materials, Spring 1973.

Use of desk calculators with low achievers in a San Francisco high school is described.

[Desk calculators, Low achievers, Secondary]

Calculators Slim Down in Size and Price. Business Week, p. 50; October 9, 1971.

The development of chips, reducing size and price of calculators, is discussed.

[Marketing]

Calculus Taught with Calculators. Machine Design 50: 4; February 9, 1978.

An NSF-sponsored project, in which calculators are used in calculus at Ohio State, is described.

[Calculus, College, Course description, Programmable calculators]

Calculators Used to Teach Calculus to College Students. Educational Technology 18: 6; January 1978.

A three-year project funded by the National Science Foundation at The Ohio State University is briefly described. Freshman calculus students are using programmable calculators; their achievement will be compared with non-calculator-using groups.

[Calculus, College, Course description, Programmable calculators, Research]

Compilation of Calculator Source Materials from NCTM and CIC. Calculators/Computers 2: 11-13; January 1978.

Selected references from the two sources are listed.

[References (selected)]

Computers: Calculator Is Almost a Computer. Electronics 47: 74, 76, 78; January 24, 1974.

Features of the HP-65 programmable calculator are discussed.

[Programmable calculators, Selection]

Computers in the Elementary School: A Course for Teachers. OCCE Special Report. Eugene: University of Oregon, Department of Computer Science, January 1975.

This special report on computers in the elementary school contains a section which discusses the role of calculators in the elementary school classroom. Included in the discussion are facts teachers should know about calculators, uses of calculators in the classroom, and ideas on how calculators might affect the curriculum. There are also suggestions for calculator activities and assignments. The course for teachers discussed in the article was tried out on five college campuses in Winter 1975. A follow-up conference was held in the Spring of 1975, and the Conference Proceedings published as an OCCE Special Report. The original article, as well as select portions of the Proceedings are available in the Computers in Education Resource Handbook published by the Department of Computer Science.

[Computers, Course description, Roles, Teachers (in-service)]

Computing, Computers, and Calculators, or The World Is Changing.
Mathematics Student 23: 1-2; October 1975.

[Roles]

Didactic Programming (George McCarty and Arthur David Snider,
editors). Laguna Beach, California: Educational Calculator
Devices, Inc.

This 'journal' on calculator-demonstrated mathematics instruction
includes articles relating to the implementation of calculator
techniques in the classroom.

[Activities, College, Programming, Secondary]

Effectiveness of Calculators in Teaching Children Both Fundamentals
and Concepts of Math. Educational Equipment and Materials,
Spring 1973.

A pilot program with pupils in grades 4-6 is reported.

[Activities, Elementary (grades 4-6), Four-function calculators]

Electronic Brains in the Classrooms - A+ or -? U.S. News & World
Report : 30; January 13, 1975.

Views are presented for and against the use of calculators.

[Pros/cons]

Electronic Calculators. Changing Times 27: 39-41; July 27, 1973.

Different characteristics of calculators are considered, with a
summary for twelve hand-held and eleven desk calculators.

[Selection]

Electronic Calculators. Flying 96: 16-17; February 1975.

The HP-65 is described and advantages are discussed for using the
calculator for figuring weight and balance, wind triangles, crab
correction angles, wind correction angles, ground speed, leg
times, and fuel consumption. Shortcomings of the calculator are
also noted.

[Aviation, Post-secondary, Programmable calculators, Pros/cons]

Electronic Calculators. In The Complete Buyer's Guide: Best Values
'75. New York: Service Communications, Guide No. 18, 1975. Pp.
49-64.

Various calculators are evaluated.

[Selection]

Electronic Calculators 1976. Hackensack, New Jersey: Buyers
Laboratory, Inc., 1976.

Features of various calculators are listed.

[Selection]

Electronic Calculators for Schools. Education in Science 75: 23-24; November 1977.

A set of guidelines is given for the selection of electronic calculators with features appropriate for junior high and secondary school students.

[Secondary, Selection]

Electronic Calculators for Use in Secondary Schools. Australian Mathematics Teacher 34: 148-149; October 1978.

Calculators which can be used in schools are discussed.

[Secondary, Selection]

Elektronisch rekenen in het Onderwijs: Opium of panacee. Utrecht, Netherlands: Instituut Ontwikkeling Wiskunde Onderwijs (IOWO), 1976.

[Pros/cons]

Games Calculators Play. Time 103: 56; June 24, 1974.

Using the calculator for games and spelling words is discussed.

[Games]

Great Calculator Debate. Nation's Schools and Colleges 1: 12, 26; December 1974.

Reasons for using or not using the calculator are discussed.

[Pros/cons]

A Guide to the Selection of Electronic Calculators. USPEC 25, Council for Educational Technology, October 1978.

[Selection]

The Hand Calculator and Its Impact on the Classroom: Report and Recommendations. Hamilton, Ontario: Hamilton Board of Education, 1978.

This report recommends the use of calculators, even during exams.

[Recommendations]

How to Pick an Electronic Calculator. Better Homes and Gardens 51: 162; April 1973.

Some features to look for when buying a hand-held calculator include floating decimal, negative function, clear key, ability to do mixed calculations, and power source.

[Selection]

How to Program Calculators for Fun and Games. Popular Electronics 11: 39-46; June 1977.

A collection of six games for the programmable calculator are presented: "Battle the Dive Bomber," "Football," "Blackjack,"

"Space Flight," "Biorhythm Forecast," and "Test Your ESP." Goals and rules are described, and programs (written in RPN for the HP-25) are included.

[Games, Programmable calculators, Programming]

HP Key Notes. Corvallis, Oregon: Hewlett-Packard.

[Activities, Programmable calculators, Programming]

Ideas for the Last Day. Sound Mathematics 7: ; May-June 1977.
(Newsletter of the Puget Sound Council of Teachers of Mathematics.)

[Activities]

Increasingly Sophisticated Custom Chips Are Turning That Lowly Calculator into a Vest-pocket Computer. Electronic Design 21: 28; 1973.

[Marketing]

Just Look at What a Little Calculator Can Do! Changing Times 31: 17-18; January 1977.

Examples are given showing how to use the calculator for figuring unit prices, discounts, sales tax, compound interest, monthly mortgage rates, and English-metric conversions.

[Consumer applications]

Mapping a Way to Learning. Arithmetic Teacher 25: 5; April 1978.

This introduction to the issue presents a pro-calculator position.

[Pros/cons]

Math in the Schools: What's Wrong? Science News 108: 325; November 22, 1975.

The NACOME recommendation on using calculators in the classroom is reported and briefly discussed.

[Elementary, Recommendations, Roles, Secondary]

Menlo College Uses Pocket Calculators in Classroom Work. College Management : 22; October 1974.

The use of calculators in Menlo College's mathematics, science, and business classes is described. Advantages of using scientific calculators are cited.

[College, Pros/cons, Roles]

Minicalculators Steal the Consumer Show. Business Week, pp. 29-30; June 16, 1973.

The market situation is reviewed.

[Marketing]

Most Sophisticated, Those New Calculators, Administrative Management 32: 38-48; March 1971.

A guide to calculators is given.

[Selection]

New Markets for Programmable Calculators. Business Week, pp. 109, 112-113; June 15, 1974.

The status and projections for sales of calculators are given.

[Marketing]

Newest Math? Newsweek 85: 50; February 3, 1975.

Pros and cons for using calculators in classrooms are cited.

[Pros/cons]

Number Sense and Arithmetic Skills, Oregon Mathematics Resource Project, Palo Alto, California: Creative Publications, 1977.

A resource box which contain a section about calculator use in the classroom.

[Activities, Kit]

Numbers Game: Games with Pocket Calculators. Newsweek 85: 66; March 17, 1975.

Several games played on calculators are described.

[Games]

The Omron Express! Mountain View, California: Omron, 1972. ERIC: ED 079 923.

This 30-page comic book was designed to introduce elementary-school children to electronic calculators.

[Activities, Elementary]

One Neat Little Way to Get Your Schools Ready for the Electronic Teaching Marvels Coming at You. American School Board Journal 160: 46-47; September 1973.

Some plans for providing electrical and communication outlets in an open-plan school are described.

[Classroom management]

Papers Presented at the Association for Educational Data Systems Annual Convention (Phoenix, Arizona). May 1976. ERIC: ED 125 658.

Included among papers on the use of computers and electronic equipment in instruction is one paper discussing the use of programmable, hand-held calculators for calculus instruction.

[Calculus, College, Programmable calculators]

Pocketing the Profits, Dun's 100: 89-90; September 1972.

The current status and future projection for the manufacture of calculators is given.

[Marketing]

Pocket Logic--Concluding Feature on Selecting a Calculator. Engineering Material and Design 19: 56: No. 10, 1975.

[Selection]

PPC Journal (Richard J. Nelson, editor). Santa Ana, California: Hewlett-Packard.

This publication contains programs for games and other activities for programmable calculators (HP-65).

[Activities, Games, Programmable calculators, Programming]

PPX Exchange. Lubbock, Texas: Texas Instruments.

[Activities, Programmable calculators, Programming]

Q.A.M.T. Statement on Calculators: Proposed Policy. QAMT Journal 1: Spring 1979. (Quebec Association of Mathematics Teachers.)

Recommendations on the use of calculators include informing administrators, teachers, and parents of the advantages of calculator use and ways in which they can be used.

[Recommendations]

Quiet Show Worries Calculator Makers. Business Week, pp. 109 ff.; June 15, 1974.

The slowdown of interest in calculator sales is described.

[Marketing]

Recommendations for the Preparation of High School Students for College Mathematics Courses. American Mathematical Monthly 85: 228-231; April 1978.

"The prevalence of inexpensive pocket calculators makes the performance of complicated calculations less tedious, but the use of calculators does not lessen the need for students to understand which concepts and operations are needed to solve a problem, to make sensible estimates, and to analyze their results." (p. 229)

"6. We recommend that computers and hand calculators be used in imaginative ways to reinforce learning and to motivate the student as proficiency in mathematics is gained. Calculators should be used to supplement rather than to supplant the study of necessary computational skills." (p. 231)

"9. . . . We suggest that, for example, the following could be de-emphasized or omitted if now in the curriculum:

(A) logarithmic calculations that can better be handled by calculators or computers, . . ." (p. 231)

[College, Recommendations]

Recreational Programmer. Kalamazoo, Michigan: Programmers Publishing Company.

Programs for calculators and computers are both included.

[Activities, Programmable calculators, Programming]

Relatorio Parcial Relativo Ao Anteprojeto De Sondagem Do "Projecto De Aprendizagem de Calculo Por Maquinas," 24 October 1975.
(Project of Learning Calculation Through Machines.)

An informal study in which 14 children were given taped interviews about calculator keys and their function is summarized. Some of the children knew how to add but few knew how to multiply.

[Calculator keys, Research]

Rescuing Rockwell's Calculators. Business Week, pp. 25-26; August 18, 1975.

Because of rapidly declining prices and accompanying inventory adjustments, profits for calculator makers have "all but disappeared," this article states. Rockwell's problems in the calculator market are discussed.

[Marketing]

Researchers Study Calculators in Elementary Schools. Wisconsin R&D Center News, Fall 1977, pp. 4-5.

The work of Weaver and Moser is discussed.

[Elementary, Research]

Sales Boom: Prices Plummet in Pocket Calculator Biz. Purchasing, November 19, 1974.

This is a brief report on the status of sales in calculators.

[Marketing]

Science Education Newsletter, No. 33. London, England: British Council, Science Department, May 1977.

This issue includes information on the use of calculators in school mathematics.

[Roles]

Selecting a Miniature Calculator--You Can Select a Slide-Rule, But Can You Choose a Calculator? Engineering Material and Design 19: 75; 1975.

[Selection]

Some Guidelines for Selecting and Testing a Minicalculator, Education Department, Secondary Schools Division, Melbourne, March 1978.

[Selection]

Some Proposals for the Use of Minicalculators in Mathematics, Education Department, Melbourne, September 1978.

[Recommendations]

SR-52 Notes (R. C. Vanderburgh, editor).

[Activities, Programmable calculators, Programming]

Those Little Calculators. Bulletin of the Council for Basic Education, p. 5; January 1975.

The impact of calculators is briefly discussed.

[Roles]

Tiny Computers That Speed Business Decisions: Programmable Calculators. Business Week: 40 ff.; January 10, 1977.

[Programmable calculators]

TI-59 Monthly Newsletter (H. Gosman, editor).

[Activities, Programmable calculators, Programming]

Tool or Crutch? Newsweek 82: 70; December 17, 1973.

Questions concerning the use of calculators (especially during college examinations) are raised.

[College, Pros/cons]

Tricks with Calculators. Machine Design 46: 170 ff.; June 13, 1974.

Some ways to use calculators are discussed.

[Activities]

Triple Nine. Calculators Computers Magazine 1: 89-90; October 1977.

This article is reprinted from Games with the Pocket Calculator by Thiagarajan and Stolovitch.

[Games]

Update: APH. APH Student Speech Plus Talking Calculator. Louisville, Kentucky: American Printing House for the Blind, 1978.

Materials being developed to help the visually handicapped use calculators are discussed.

[Handicapped (blind)]

Update on Calculators. Education U.S.A., May 1, 1978.

A summary of Suydam's comments on calculator use made at the 1978 NCTM meeting are given.

[Pros/cons, Roles]

Use of Hand Calculators in Schools Widens, a Few Still Urge Caution.
ASCD News Exchange 17: 8; May 1975.

[Pros/cons]

Using Calculators in the School Classroom. Ohio Schools 54: 22-24,
31-32; March 26, 1976.

[Roles]

Utilizing an Electronic Calculator. A Manual for Planning and Development. January 1970. ERIC: ED 038 030.

An electronic calculator was used to aid mathematics instruction in grades 11 and 12. Requirements for implementing the program are described and illustrated by experiences at the pilot school. A curriculum guide is given for the inservice teacher training program, and suggestions for using the calculator in a mathematics program are included.

[Curriculum, Desk calculators, Secondary (grades 11-12), Teachers (in-service)]

Viewpoints: Calculators in the Classroom. MATYC Journal 12: 5;
Winter, 1978.

This editorial supports a policy of use of calculators only after students have mastered new calculation skills at any level.

[Pros/cons]

Viewpoints: Probable Quotes From History. MATYC Journal 12: 189;
Fall, 1978.

[Pros/cons]

West Virginia Council of Teachers of Mathematics Position Paper on
Calculators in the Classroom. West Virginia CTM Newsletter :
9-10; Fall 1978.

[Elementary, Recommendations, Secondary]

Where Do You Stand? Computational Skill is Passe. Mathematics Teacher 67: 485-488; October 1974.

A survey of teachers, mathematicians, and laymen is reported, with seven questions and percentage of responses noted.

[Attitudes, Research (survey)]

World Electronics Markets: Mounting a Push Toward a Slow Modest
Recovery. Electronics 49: 83-106; January 8, 1976.

Projections on sales of calculators are included amid much other data.

[Marketing]

- 5^a Conferencia Interamericana de Educacao Matematica (Fifth Inter-american Conference of Mathematics Education), Campinas, Brasil, February 1979.

This conference report contains abstracts of several presentations on calculator research.

[Research]

- 1978 Buying Guide to Electronic Calculators, MATYC Journal 12: 229-235; Fall 1978.

This is an excerpt from the report by Buyers Laboratory, noting features, programming capability, and other factors for a wide variety of calculators.

[Selection]

- 1984: A Calculator on Every Wrist and in Every School Desk, Too. Nation's Schools and Colleges, p. 13; December 1974.

What will be available for calculators is predicted by Mullish. He expects many of the sophisticated capabilities now on expensive models, such as programming capacity, to be found on most standard models in a few years.

[Marketing]

INDEX

This index is designed to help the user locate references to designated areas of concern related to the use of calculators in education. It should be noted that the cross-referencing is not exhaustive: there may be other references which could be pertinent, but have been omitted due to oversight.

The following topics are included in the index:

Achievement	Games
Activities	Gender
Addition	General mathematics
Algebra	Geometry
Algorithms	Gifted
Anxiety	Grade analysis
Attitudes	Handicapped
Basic mathematics	History
Biology	Industrial education
Building	Integers
Business	Iteration
Business education	Junior high
Business mathematics	Kit
Calculator keys	Learning disabilities
Calculator logic	Logarithms
Calculator memory	Low Achievers
Calculus	Marketing
Checking	Measurement
Chemistry	Mixed operations
Classroom management	Multiplication
College	Naval applications
Consumer applications	Nondecimal bases
Course description	Notation
Curriculum	Numerical analysis
Decimals	Pattern searches
Derivatives	Percent
Desk calculators	Pharmacy
Diagnosis	Physical education
Differential equations	Physics
Division	Place value
Drill	Post-secondary
Economics	Powers
Electronics	Preprogrammed devices
Elementary	Prime numbers
Engineering	Principals
Estimation	Probability
Exponents	Problem solving
Evaluation	Programmable calculators
Finance	Programming
Flow charts	Proofs
Four-function calculators	Properties
Fractions	Pros/cons
Functions	Rational numbers

Ratios
Reciprocals
Recommendations
References (selected)
Remedial
Research
Roles
Roots
Science
Scientific calculators
Secondary
Selection
Significant figures
Slide rule
Solution methods
Statistics
Status report
Subtraction
Teachers
Technical mathematics

Technical occupations
Testing
Time
Trigonometry
Units
Vocational agriculture
Worksheets

Australia
Brazil
England
France
Ireland
Israel
Luxembourg
Netherlands
New Zealand
South Africa
Sweden
West Germany

Achievement

Advani, 1972
Aldridge, 1977
Allen, 1976
Anderson, 1977
Ayers, 1977, 1979
Betts, 1937
Bolesky, 1977
Boling, 1977
Borden, 1977
Broussard et al., 1969
Burger, 1974
Campbell and Virgin, 1976a
Channell, 1978
Chasson, 1977
Cooper, A., 1978
Coward, 1978
Durrance, 1965
Dyke, 1978
Eckmier, 1978
Ellis and Corum, 1969
Ethelberg-Laursen, 1978
Fehr et al., 1956
Fesharaki, 1979
Findley, 1967
Fischman, 1976
Gooden, 1978
Hawthorne and Sullivan, 1975
Hector, 1979
Hopkins, B., 1978
Hutton, 1977, 1978a
Jamski, 1977, 1979
Johnson, R., 1971
Jones, E., 1976
Keough and Burke, 1969

Achievement (continued)

Klimas, 1979
Kobrin, 1978
Kolpas, 1978
Koop, 1978
Ladd, 1974
Laursen, 1978
Lenhard, 1977
Longstaff, et al., 1968
Mastbaum, 1969
Mcanelly, 1978
Miller, D. P., 1977
Muzeroll, 1976
Nelson, 1976
Nichols, 1976
Papritan, 1978
(Philadelphia), 1975a
Prigge and Langemo, 1978
Quinn, 1976
Rudnick and Krulik, 1976
Schnur and Lang, 1976
Schott, 1976
Shea, 1974
Smith, B., 1978
Spencer, 1975
Stocks, 1972
Toole, 1979
Vaughn, 1977
Wajeesh, 1976
Ward, 1979
Whitaker, 1977
Williams, 1979
Wilson, A., 1978
Zepp, 1976

Activities

Ahl, 1978
 Angus, 1978
 Averett et al., 1977
 Babani, 1978
 Beardslee, 1978
 Biesse et al., 1976
 Bell, A. et al., 1978
 Benrey, 1976
 Birtwhistle, 1978
 Bitter, 1977a
 Boyle, 1976
 Brown, L., 1976
 Bruni and Silverman, 1976
 Capoferri and Winowski, 1975
 Caravella, 1977b
 Carman, 1978
 Carney, 1978
 Chaney, 1977
 Chinn et al., 1978
 Cooper, R., 1976
 D'Ambrosio, -
 Davidson, J., 1976, 1978
 Dolan, 1976
 (Durham), 1976
 Edsall et al., 1976
 Engel, 1974
 Etlinger and Vitale, 1977
 Fielker, 1976
 Frenzel, 1975
 Friesen, 1976
 Gardner, 1976
 Gilbert, 1975
 Gilbreath et al., 1978
 Goodson, 1978a
 Goult and Pratt, 1977
 Gregory, 1974
 Guthrie and Wiles, 1976
 Hamada, 1978
 Hartman, 1977
 Hauser, 1978
 Hemer, 1977
 Henry, L., 1977
 Hiatt, 1979
 Huff, 1974, 1976, 1977-1979
 Humphreys et al., 1977
 Hyatt and Feldman, 1979
 Immerzeel, 1976d, e
 Immerzeel and Ockenga, 1977
 (Iowa), 1975a, b, c
 Irvin, 1978

Activities (continued)

Jacobs, 1977
 Jamele, 1975
 Jamski, 1978, 1979b
 Jansson, 1978
 Jefimenko, 1975
 Jewell, 1979c
 Johnson, D., 1978
 Johnson, R., 1971
 Joneson, 1978
 Judd, 1974, 1975b
 Kahn, 1976
 Kaufman and Haag, 1977
 Kerr, 1979
 Kissane, 1978
 Kremer, 1976
 LeMont et al., 1977
 Lloyd, 1978
 Maor, 1976a
 McEvoy, 197
 McHale and Witzke, 1978
 Meissner, 1977f, 1978c, e
 Mendoza, 1975
 Meserve and Sobel, 1977
 (Michigan), 1977
 Miller, D., 1977, 1979
 Morris, 1977b
 Moursund, 1977a, b, 1978
 Mullish, 1976, 1977
 NCTM, 1976a, b
 Neill, 1977, 1978, 1979
 Neufeld, 1977
 (New York), 1978b
 (Novus), 1974a, b
 (Nuffield), 1968
 Ockenga, 1976
 O'Daffer, 1976
 Oglesby, A., 1977
 Oswald, 1978
 Pallas and Behr, 1976
 Papy, 1977
 Pask, 1977
 Peckham and Weir, 1978
 Pederson, 1977
 Peterson, A., 1975
 Prigge and Gawronski, 1978
 Prigge and Mauland, 1978
 Råde, 1977
 Råde and Kaufman, 1976, 1977
 Reeves, 1975
 Reys et al., 1979

Activities (continued)

Roberts, E., 1974
 Robinson, 1976, 1977
 Rogers, J. B., 1977
 Rogers, J. T., 1975a, b, 1976, 1978
 Rudolph and Claassen, 1976
 Schlossberg and Brockman, 1975
 Schoen, 1979
 Schwob, 1976
 (Sharp), 1975
 Sharp, 1977
 Sharron and Links, 1975
 Skoll, 1975
 Snover and Spikell, 1979d
 Steinbrocker, 1975
 Stephen and Trueman, 1977
 Stephens, 1978
 Stover, 1977
 Stultz, 1975
 Sullivan, 1976
 Sutz, 1975
 Suydam et al., 1978
 (Texas Instruments), 1976b, c, d,
 e, f; 1977a, e, f, g
 Thompson, 1978
 Troutman and Lichtenberg, 1977
 Vail, 1974
 Van Atta, 1967
 Vannatta, 1976
 Vervoort and Mason, 1977
 Vine, 1975, 1978
 Vitale, 1977
 Wavrik, 1978a, b, c, e
 Weaver, 1977a, b, c; 1978a, b
 Wehner, 1975
 Wohlfort, 1972

Addition

Greenfeder, 1975
 Koller and Mulhern, 1977a, b
 Kremer, 1976
 Weaver, 1976b

Algebra

Bawtree, 1979
 Fraser, 1976
 Hutton, 1977
 Ladd, 1976
 Lipsey, 1978

Algebra (continued)

Olson, 1979
 Peterson and Capoferi, 1976
 Quinn, 1976
 Rees et al., 1978
 Russakoff, 1979
 Schultz, 1978a
 (Texas Instruments), 1977f
 Waits, 1977, 1978b
 Weaver, 1978c

Algorithms

Ball, 1977
 Engel, 1978
 Friedlander, 1978
 Frye, 1974
 Gaslin, 1972, 1975
 Hobbs and Burris, 1978
 Nijenhuis and Wilf, 1978
 Schmalz, 1978
 Weaver, 1978c

Anxiety

Lunder, 1979
 Quinn, 1976

Attitudes

Advani, 1972
 Anderson, 1977
 Ayers, 1977, 1979
 Beardslee, 1977
 Bell, M., 1976
 Boling, 1977
 Borden, 1977
 Bukowski, 1975
 Campbell and Virgin, 1976a, b
 Cech, 1970, 1972
 Cooper, A., 1978
 Coward, 1978
 Dyce, 1978
 Eckmier, 1978
 Ellis and Corum, 1969
 Fehr et al., 1956
 Fischman, 1976
 Geisinger and Roberts, 1978
 Gooden, 1978
 Graeber et al., 1977

Attitudes (continued)

Hector, 1979
Hopkins, B., 1978
Huffman, 1977
Hutton, 1977, 1978a
Jones, E., 1976
Koop, 1978
Ladd, 1974
Laursen, 1978
Lenhard, 1977
Longstaff et al., 1968
Mastbaum, 1969
Muzeroll, 1976
Nelson, 1976
Nichols, 1976
Papritan, 1978
Parks, 1977
(Philadelphia), 1975a, b
Prigge and Langemo, 1978
Royce and Shank, 1977
Rudnick, 1978
Rudnick and Krulik, 1976
Shea, 1974
Shin, 1978
Smith, B., 1978
Stocks, 1972
Vaughn, 1977
Wajeesh, 1976
Ward, 1979
Whitaker, 1977
Williams, 1979
Williams and Tobin, 1978
Yvon and Downing, 1978

Basic mathematics

Dubisch and Hood, 1979
Dyce, 1978
Hopkins, B., 1978
Nichols, 1976

Biology

Vail, 1974

Building

Berger, 1975
Berkowitz, 1973
Henry, D., 1978

Building (continued)

Levy, 1977
Marshall and Hussey, 1978
McWhorter, 1976
Meyer, 1975, 1976
Miller, P., 1976
Shapiro, 1975
Stanford, 1977
Stearns, 1976
Tenny, 1977
Tyler, T., 1975, 1976
Wilson and Funderburk, 1976

Business

Comarow, 1974
Free, 1976
Kinzey, 1975, 1976
Kissler et al., 1978
LeBarre et al., 1975
Locke, 1978
Locke and Dehr, 1974
Mcanelly, 1978
McCready, 1972 (1977)
Meconi, 1977
Meehan et al., 1975
Smith, J. M., 1976
(Texas Instruments), 1978

Business education

Andrews, 1972
Aronofsky et al., 197
Berg, 1970
Bormann, 1973
Bryant, 1973
Cantor, 1974
Carter and Young, 1975
Dohleman, 1973
Giordano, 1971
Huffman, 1977
Huffman and Welter, 1976
Madaus and Yrle, 1976
McShane, 1972
Merchant, 1974
Miller, L., 1975
Miller, R., 1975
Phillips and Storey, 1976
Quinn, M., 1974, 1975
Smith, B., 1978
Wasson, 1972

Business mathematics

Bukowski, 1975
Fischman, 1976
Shirey, 1976
Shuch, 1976

Calculator keys

Albrecht, 1977-1978

Calculator logic

Bakke, 1978
Beakly and Leach, 1975
Friedlander, 1978
Hewlett-Packard, 1974
Mims, 1976
Moursund, 1978
Snover and Spikell, 1979f
Toth, 1978c

Calculator memory

Albrecht, 1977-1978
Billings and Moursund, 1978d
Greenfeder, 1975

Calculus

D'Ambrosio,
Johnsonbaugh, 1976
McCarty, 1975
Neill, 1977, 1978, 1979
O'Loughlin, 1976
Ratti and Manougian, 1977
Williams and Jones, 1979

Checking

Advani, 1972
Drake, 1978
Hallden-Abberton and Waits, 1978
Riden, 1975

Chemistry

Bolesky, 1977
Clark, C. et al., 1975
Hayman, 1977
Henry, D., 1978
Herron, 1977
Holdsworth, 1977a, b
Hughes and Bundschuh, 1978
Karp, 1975a, b
McWilliam, 1974
Scaife, 1978
Seymour and Fernando, 1977
Snadden and Runquist, 1975
Sosebee and Walsh, 1975
Weldert, 1977

Classroom management

Barnard, 1976
Bell, M., 1976
Caravella, 1977b
Fielker, 1976
(Minneapolis), 1976-77

College

Addis, 1978
Ayers, 1977, 1979
Babani, 1978
Ball, 1977
Bradshaw, 1978
Briggs, 1978
Buck and Buck, 1976
Bukowski, 1975
Burger, 1974
Clark, C. et al., 1975
Coons, 1978
Cooper, A., 1978
Coward, 1978
Craver, 1976
D'Ambrosio, -, -, -
DeJong, 1975
Dodge, 1976
Dubisch and Hood, 1979
Dunlop, 1978
Dyce, 1978

College (continued)

Eisberg, 1976, 1978
Engelsohn, 1978
Forbes, 1978
Gazdar, 1978
Giesinger and Roberts, 1978
Gooden, 1978
Greenfeder, 1975
Hallden-Abberton and Waits, 1978
Hartman, E., 1978
Hayman, 1977
Hector, 1979
Henrici, 1977
Henry, D., 1978
Hickey, 1970
Holdsworth, 1977a
Huffman, 1977
Hughes and Bundschuh, 1978
Hyatt and Feldman, 1979
Hyatt et al., 1977, 1979
Jewell, 1979b
Jordan, 1977
Kenner, 1976
King, 1978
Kissler et al., 1978
Kitchen, 1971
Koop, 1978
Krise and Burkett, 1977
Leitzel and Waits, 1976
Lim and Tseng, 1976, 1977
Lorthup and Jones, 1975
Lowry, 1977
Maor, 1976b
McCarty, 1975
McLeod and Adams, 1979
Miller, R., 1975
Neill, 1977, 1978, 1979
Nichols, 1976
Nijenjuis and Wilf, 1978
Noll, 1976a, b, c, 1977
O'Loughlin, 1976
Peckham and Weir, 1978
Phillips, 1977
Råde, 1977
Ratti and Manougian, 1977
Rees et al., 1978
Reiland, 1978
Roberts and Fabrey, 1977, 1978
Roberts and Glynn, 1976, 1977,
1978a, b, 1979
Roberts and Lerner, 1978
Roberts et al., 1978

College (continued)

Scaife, 1978
Schlaphoff, 1975
Schmidt, 1977
Schultz and Waits, 1979
Seymour and Fernando, 1977
Shearer, 1976
Shuch, 1976
Sidran, 1977
Sloyer and Tingey, 1979
Smith, B., 1978
Smith, J. M., 1975, 1977
Snadden and Runquist, 1975
Snover and Spikell, 1978, 1979a, f
Sosebee and Walsh, 1975
Spero, 1977
Summers, 1978a
Utterback, 1975
Vincent, 1976
Waits, 1978b
Wolfe, 1978
Zepp, 1976
Zimmermann, 1978
Zwas and Breuer, 1975

Consumer applications

Birtwhistle, 1977
Boling, 1977
Buckwalter, 1975a, b
Comarow, 1974, 1975
Feldzamen and Henle, 1973
Field, 1975
Frenzel, 1975
Frye, 1972
Greynolds et al., 197-
Hunter, 1974
Hyatt et al., 1977
Jamski, 1979b
Mullish, 1974
Salisbury, 1976
Shirey, 1976
Smeets, 1978
Steuer, 1978
(Texas Instruments), 1976a
Thompson, 1978
Tufte, 1977
Whatham, 1977
Wilderman, 1977

Course description

Andrews, 1972
Bourjaily and Radachy, 1977
Burger, 1974
Frandsen, 1976
Fritz, 1975
Giordano, 1971
Jewell, 1979b
Kreinberg, 1978
Leitzel and Waits, 1976
Lorthup and Jones, 1975
Maor, 1978
McShane, 1972
Rising et al., 1978
Smith, C., 1976
Zwas and Breuer, 1975

Curriculum

Bell, M. et al., 1977
Billings and Moursund, 1978a
DeQuetroz, 1977
Ferreira, 1977
Gilbreath et al., 1978
Jewell, 1979a
Mansilla, 1977
Meissner, 1976b; 1977c, f, g;
1978a, b, e; -, -
Mortari and Polidoro, -
Nebel, 1977
Papy, 1977
Pollak, 1977
Posamentier, 1975
Rising, 1979
Sieber et al., 1978
Suydam, 1976a
Wheatley, G., 1979

Decimals

Allen, 1976
Borden, 1977
Fesharaki, 1979
Kilmer, 1978
Knowles, 1979
Krause, 1978b
Lichtenberg, 1978
Morris, 1978a
Ounsted, 1978
Pallister, 1977

Decimals (continued)

Smith, G., 1978
Sutherlin, 1977
Turnbull et al., 1977
Tyler, K., 1977
Vaughn, 1977
Wagner, 1979

Derivatives

Morgan and Warnock, 1978

Desk calculators

Advani, 1972
Albrecht et al., 1973
Aldridge, 1977
Andrews, 1972
Asmus, 1972
Beck, 1960
Berg, 1970
Betts, 1937
Broussard et al., 1969
Buchman, 1969
Cech, 1970, 1972
Clark and Barandes, 1977
Durrance, 1965
Ellis and Corum, 1969
Fehr et al., 1956
Fielker, 1976b
Findley, 1967
Gaslin, 1972, 1975
Giordano, 1971
Gottheimer, 1978
Hayman, 1977
Hickey, 1970
Hohlfeld, 1974
Johnson, R., 1971
Karp, 1975b
Keough and Burke, 1969
Kinzey, 1976
Ladd, 1974
Lavoie, 1968
Lesjack, 1970
Locke and Dehr, 1974
Longstaff et al., 1968
Marsh and Smith, 1976
Mastbaum, 1969
McCready, 1972 (1977)
McShane, 1972

Desk calculators (continued)

Merchant, 1974
Millikin and Siegel, 1970
(Nuffield), 1968
O'Loughlin, 1976
Phillips and Storey, 1976
Schilt, 1962
Schott, 1955
Shea, 1974
Smith, J. R., 1973
Stocks, 1972
Triggs, 1966
Tweddale, 1976
Van Atta, 1967

Diagnosis

Bitter et al., 1977

Differential equations

Buck and Buck, 1976

Division

Miller, D. P., 1977
Prigge and Langemo, 1978
Toth, 1978a, b

Drill

Gregory, 1977
Hohlfeld, 1974
Irvin, 1978

Economics

Addis, 1978

Electronics

Noll, 1977
Reys et al., 1979

Elementary

Aldridge, 1977
Allen, 1976
Averett et al., 1977
Barnard, 1976
Barrett and Keefe, 1974
Beardslee, 1978
Beck, 1960
Beisse et al., 1976
Bell, A. et al., 1978
Bell, M., 1976
Bell, M. et al., 1977
Betts, 1937
Bitter, 1977a, b
Bitter and Metos, 1977
Bitter and Nelson, 1975
Blume and Mitchell, 1979
Borden, 1977
Bright, 1978
Bruni and Silverman, 1976
Campbell and Virgin, 1976a, b
Capoferi, 1977
Capoferi and Winowski, 1975
Channell, 1978
Chasson, 1977
Clark, J., 1971
Davidson, J., 1976, 1978
Davies, 1978
de Cortex, 1976
Dolan, 1976
Durrance, 1965
Eckmier, 1978
Elder, 1975
Engel, 1974
Ethelberg-Laursen, 1978
Etlinger and Vitale, 1977
Fehr et al., 1956
Fielker, 1976a, b
Gregory, 1977
Haigh, 1978
Hale, 1974
Hatfield, 1978a, b
Hawthorne and Sullivan, 1975
Hohlfeld, 1974
Hutton, 1978a
Immerzeel, 1976e
Immerzeel and Ockenga, 1977
(Iowa), 1975a, b, c; 1978
Jacobs, 1977
Jones, C., 1974
Jones, E., 1976

Elementary (continued)

Kasnic, 1978
Kessner, 1975
Klimas, 1979
Kobrin, 1978
Krause, 1978a
Lesjack, 1970
Longstaff et al., 1968
Lowerre et al., 1978
Maor, 1978
Mason, 1979
McLeod and Adams, 1979
Meissner, 1977f, 1978a, b, c, e; -
(Michigan), 1977
Miller, D., 1977, 1979
Miller, D. P., 1977
Moser, 1979
Moursund, 1977a, b
NACOME, 1975
Nebel, 1977
Nelson, 1976
Nielsen and Loiacono, 1977
(North Carolina), 1978
Ockenga and Duea, 1979
Oswald, 1978
Pallas and Behr, 1976
Papy, 1977
Parks, 1977
Prigge and Gawronski, 1978
Prigge and Langemo, 1978
Prigge and Mauland, 1978
Riden, 1975
Robinson, 1976
Scandura et al., 1976, 1978
Schafer et al., 1975
Schilt, 1962
Schlossberg and Brockman, 1975
Schnur and Lang, 1976
Schoen, 1979
Schott, 1955
(Sharp), 1972
Shea, 1974
(Shell), 1977
Shin, 1978
Shumway, 1979
Shumway et al., 1979
Spencer, 1975
Sullivan, 1976
Sutherlin, 1977
Taylor, 1976
(Texas Instruments), 1976d, 1977e
Thiagarajan and Stolvitch, 1976

Elementary (continued)

Triggs, 1966
Vine, 1975
Wavrik, 1978e, f, g
Weaver, 1976a, b
Webb, 1976
Weiss, 1978
Wheatley, C., 1979
Wheatley, G., 1979
Whitaker, 1977
Wilderman, 1977
Wilson, A., 1978
Yvon and Downing, 1978

Engineering

Budlong, 1972
Kenner, 1976
Kitchen, 1971
Lorthup and Jones, 1975
Noll, 1976a, b, c
Sinha, 1977

Estimation

Bruni and Silverman, 1976
Fesharaki, 1979
Hopkins, B., 1978
Lawson, 1978
Ockenga and Duea, 1978, 1979
Sutherlin, 1977

Exponents

Van Atta, 1967
Waits, 1977

Evaluation

Nielsen and Loiacono, 1977

Finance

Greynolds et al., 197
Smith, J. M., 1976
(Texas Instruments), 1978

Flow charts

Berg, 1970
Gazdar, 1978
(New York), 1978a
Oglesby, M., 1977b
Schlaphoff, 1975
Snover and Spikell, 1979e

Four-function calculators

Adkins, 1977
Albrecht, 1977-1978
Bahe, 1974
Barnard, 1976
Barrett and Keefe, 1974
Beardslee, 1978
Beisse et al., 1976
Birtwhistle, 1977
Bitter, 1977b
Boyle, 1976
Chasson, 1977
Dolan, 1976
Fielker, 1976b
Gilbreath et al., 1978
Hawthorne and Sullivan, 1975
Hyatt and Feldman, 1979
Jamele, 1975
Lawson, 1978
Meissner, 1978e
Morris, 1978b
Oglesby, M., 1977a
Oswald, 1978
Papritan, 1978
Priest, 1973
Riden, 1975
Scandura et al., 1976, 1978
Schafer et al., 1975
Scott, 1978a
(Sharp), 1972
Simons, 1977
Stephen and Trueman, 1977
Suydam et al., 1978
Thiagarajan, 1977
Waits, 1978a
Weaver, 1976a, b

Fractions

Hector, 1979
Usiskin, 1979
Willson, 1978a

Functions

Crothamel, 1978
Michelow and Vogeli, 1978

Games

Ahl, 1978
Albrecht, 1977-1978
Austin, 1979
Beardslee, 1978
Blakeley, 1979
Clarke, J., 1978
Davidson, J. J., 1978
Donner and Matus, 1977
Dunlop, 1978
Forbes, 1978
Gardner, 1976
Goodhue, 1978
Goodson, 1978a
Hartman, 1977
(Hewlett-Packard), 1977
Hutton, 1978b, c
Judd, 1974, 1975a, b, 1976, 1977
Lappan and Winter, 1978
Lesjack, 1970
Ockenga and Duea, 1979
Oglesby, M., 1977a, b
Olney and Olney, 1977
Pallas and Behr, 1976
Papy, 1977
Pask, 1977
Rhodes, 1977
Rogers, J. T., 1975
Schlossberg and Brockman, 1975,
1977a, b
Seymour, T., 1975
(Texas Instruments), 1976b, 1977c
Thiagarajan, 1975, 1977
Thiagarajan and Stolvitch, 1976
Vine, 1975, 1978
Yarbrough, 1976

Gender

Geisinger and Roberts, 1978
Jones, E., 1976
Ward, 1979
Wilson, A., 1978

General mathematics

Cech, 1970, 1972
Gaslin, 1972, 1975
Laursen, 1978
(Minneapolis), 1976-77
Toole, 1979
Vaughn, 1977
Wajeeth, 1976
Ward, 1979
Williams, 1979

Geometry

Bolduc, 1977
Hallerberg, 1978
Hiatt, 1977, 1978
Jurgensen, 1978
Maor, 1976b
Van Atta, 1967

Gifted

Maor, 1978
Millikin and Siegel, 1970

Grade analysis

Garst, 1977

Handicapped

Champion, 1977
Gallery, 1978
Goodrich et al., 1977
Janota, 1977
Koller and Mulhern, 1977a, b
Luxton and Spungin, 1976
Smeets, 1978
Stocks, 1972
Thornton, 1976

History

D'Ambrosio
Lachenbruch, 1978
Mims, 1972
Moursund, 1977a, b

Industrial education

Meconi, 1977

Integers

Aviv, 1979
Keller, 1978
Nicolai, 1978

Iteration

Snover and Spikell, 1979e

Junior high

Aidala, 1978
Aidala and Rosenfeld, 1978
Aldridge, 1977
Anderson, 1977
Billstein and Lott, 1978
Bitter and Nelson, 1975
Broussard et al., 1969
Brown, L., 1976
Davidson, J., 1976, 1978
Dolan, 1976
Durrance, 1965
Etlinger and Vitale, 1977
Fesharaki, 1979
Gallery, 1978
Goodson, 1978a, b
Immerzeel, 1976e
Immerzeel and Ockenga, 1977
(Iowa), 1978
Jacobs, 1977
Jamski, 1977, 1979
Johnson, R., 1971
Kelley and Lansing, 1975
Koller and Mulhern, 1977a, b
Krause, 1978a
Lenhard, 1977
Maor, 1978
Mastbaum, 1969
Miller and Hazekamp, 1978
Millikin and Siegel, 1970
Mims, 1977
Muzeroll, 1976
Nelson, 1976
(North Carolina), 1978
Ockenga, 1976

Junior high (continued)

Ockenga and Duea, 1979
Pallas and Behr, 1976
(Philadelphia), 1975a
Quinn, 1976
Royce and Shank, 1977
Rudnick, 1978
Rudnick and Krulik, 1976
Schlossberg and Brockman, 1975
Schnur and Lang, 1976
Schott, 1955
Sharp, 1977
Szetela, 1978a, b
Thiagarajan and Stolvitch, 1976
Toth, 1978a, b
Weaver, 1977a, b, 1978a, b

Kit

Judd, 1977
Millikin and Siegel, 1970
(North Carolina), 1978
Sharp, 1977
Stephen and Trueman, 1977
(Texas Instruments), 1976e, 1977e, f, g

Learning disabilities

Advani, 1972

Logarithms

Bahe, 1974
Jordan, 1977
Leaton, 1975
Simons, 1977
Willson, 1978b

Low achievers

Broussard et al., 1969
Cech, 1970, 1972
Eckmier, 1978
Ellis and Corum, 1969
Gaslin, 1972, 1975
Humphreys et al., 1977
Kelley and Lansing, 1975
Kolpas, 1978
Ladd, 1974
Mastbaum, 1969

Marketing

Comarow, 1975
Field, 1977
Garner, 1977
Majumdar, 1977
Mims, 1974
Offenheiser, 1972
Tashjian, 1977

Measurement

Aidala and Rosenfeld, 1978
Allen, 1976
Hale, 1974
Krause, 1978a
Nebel, 1977
Wahl, 1977
Werner, 1978

Mixed operations

Albrecht, 1977-1978
Bitter, 1977b
Bourjaily and Radachy, 1977
Bruni and Silverman, 1976
Carney, 1978
Chinn et al., 1978
Ethelberg-Laursen, 1978
Goodhue, 1978
Gregory, 1977
Hopkins, B., 1978
Nebel, 1977
Ockenga and Duea, 1979
Rade and Kaufman, 1976, 1977
Russell, 1977
Smith, S., 1978
Toth, 1978c
Vincent, 1976
Weaver, 1976a, 1977a, b, 1978a, b

Multiplication

Channell, 1978
Fehr et al., 1956
Hohlfeld, 1974
Hutton, 1978b, c
Prigge and Langemo, 1978
Toth, 1978a, b

Naval applications

Kruse and Burkett, 1977

Nondecimal bases

Adkins, 1977
Fletcher, 1976
Riden, 1975
Schultz, 1978b
Toth, 1978c

Notation

Ducharme, 1978
Hartman, E., 1978

Numerical analysis

Snover and Spikell, 1979e

Pattern searches

Aviv, 1979
Bright, 1978
Greenwood, 1977
Keller, 1978
Schmalz, 1978
Watson, 1978
Woodburn, 1976

Percent

Fesharaki, 1979
Vaughn, 1977

Pharmacy

Lim and Tseng, 1976, 1977

Physical education

Miller, D. I., 1974
Vincent, 1976

Physics

Beare, 1977a, b, c
Briggs, 1978
Eisberg, 1976, 1978
Marsh and Smith, 1976
Marshall and Hussey, 1978
Mendoza, 1975
Osborne, 1974
Phillips, 1977
Pitcairn and Baker, 1974
Reiland, 1978
Sidran, 1977
Smith, C., 1976
Summers, 1978a, b

Place value

Austin, 1979
Russell, 1977

Post-secondary

Aronofsky et al., 197
Carney, 1978
Fitzgerald, 1976
Greynolds et al., 197
Mcanelly, 1978
Smeets, 1978
Tufte, 1977

Powers

Albrecht, 1977-1978
Bravin, 1973
Friedlander, 1978
Hutton, 1977
Krist and Jewell, 1978
Papy, 1975
Priest, 1973

Preprogrammed devices

Haigh, 1979
Irvin, 1978
(Texas Instruments), 1976b

Prime numbers

Cohen, 1976

Principals

Campbell and Virgin, 1976b

Probability

Sloyer and Tingey, 1979

Problem solving

Aidala, 1978
Aidala and Rosenfeld, 1978
Albrecht, 1977-1978
Beare, 1977a, b
Betts, 1937
Billings and Moursund, 1978a, b, c, d
Bruni and Silverman, 1976
Clyde, 1978
D'Ambrosio, 1977, 1978b
D'Ambrosio, -, -
Davies, 1978
DeJong, 1975
Dodge, 1976
Edwards, 1978
Hiatt, 1979
Hopkins, B., 1978
(Iowa), 1975a, b, c; 1978
Jacobs, 1977
Johnston, D., 1978a
Judd, 1975a, 1977
Kasnic, 1978
Kibler and Campbell, 1976
Klimas, 1979
Krause, 1978b
Litwiller and Duncan, 1977
Mason, 1979
Meissner, 1978d
Miller, L., 1975
Morris, 1978b
Moursund, 1977c
(New York), -
North, 1975
(North Carolina), 1978
Papritan, 1978
Papy, 1975
Råde and Kaufman, 1976, 1977
Roberts and Fabrey, 1977, 1978

Problem solving (continued)

Roberts and Glynn, 1976, 1977,
1978a, b, 1979
Roberts and Lerner, 1978
Roberts et al., 1978
Roberts, J. B., 1978
Rogers, J. T., 1975
Schlaphoff, 1975
Schultz and Waits, 1979
Snover and Spikell, 1979b, c
Spero, 1978
Suydam et al., 1978
Teitelbaum, 1978
Utterback, 1975
Vervoort and Mason, 1977
Vitale, 1977
Ward, 1979
Whatham, 1977
Wheatley, C., 1979

Programmable calculators

Addis, 1978
Aronofsky et al., 197
Ball, 1977
Bawtree, 1979
Beare, 1977a, b, c
Blodgett, 1976
Bradshaw, 1978
Buck and Buck, 1976
Clark, C. et al., 1978
Dunlop, 1978
Eisberg, 1976, 1978
Eisberg and Hyde,
Engelsohn, 1978
Forbes, 1978
Free, 1976, 1977a
Garst, 1977
Gazdar, 1978
Gottheimer, 1978
Hallden-Abberton and Waits, 1978
Henrici, 1977
Herron, 1977
(Hewlett-Packard), 1976a, 1977
Hoffmann, 1977
Holdsworth, 1977a
Hughes and Bundschuh, 1978
Johnston, D., 1978a, b, c
Kenner, 1976
Kruse and Burkett, 1977
LaBar et al., 1974
Maor, 1978

Programmable calculators (continued)

McWilliam, 1974
Meyer, 1976
Mims, 1976
Oglesby, M., 1977a, b
Peckham and Weir, 1978
Pederson and Sharrah, 1979
Peters, 1977
Phillips, 1977
Pitcairn and Baker, 1974
Quinn, 1976
Rade, 1977
Reiland, 1978
Reubens, 1978
Rising et al., 1978
Sandery, 1974
Schlaphoff, 1975
Schmidt, 1977
Seymour and Fernando, 1977
Shearer, 1976
Sippl, 1976a, b
Sippl and Kidd, 1975
Sippl and Sippl, 1978
Sloyer and Tingey, 1979
Smith, C., 1976
Snadden and Runquist, 1975
Snover and Spikell, 1978, 1979a, b,
c, d, e, f
Summers, 1978a, b
(Texas Instruments), 1977b, d
Vail, 1974
Wavrik, 1978a, b, c, e, f, g
Wolfe, 1978
Zimmerman, 1978

Programming

Albrecht, 1977-1978
Bawtree, 1979
Eisberg, 1976
Engelsohn, 1978
Free, 1977a
Gazdar, 1978
(Hewlett-Packard), 1976a
Johnston, D., 1978a, b, c
Kenner, 1976
Meyer, 1976
Mims, 1976
Oglesby, 1977b
Peckham and Weir, 1978
Peters, 1977
Phillips, 1977

Programming (continued)

Pitcairn and Baker, 1974
Reiland, 1978
Reubens, 1978
Schmidt, 1977
Sloyer and Tingey, 1979
Snover and Spikell, 1979e
(Texas Instruments), 1977b, d
Wavrik, 1978a, b, c, e, g
Zimmerman, 1978

Proofs

Snover and Spikell, 1978

Properties

Kaufman and Haag, 1977
Meissner, 1978d

Pros/cons

Bartusiak, 1978
Bell, M., 1976
Bell, M., 1978
Bell, M. et al., 1977
Birtwhistle, 1974
Buckwalter, 1975a
Butler, 1978
Clarke, R., 1978
D'Ambrosio, 1977
Etlinger, 1974
Fielker, 1973
Giese, 1978a, b
Grosswirth, 1975
Gwynne, 1975
Harrington, 1976
Hawthorne, 1973
Johnson, D., 1978
Kessner and Slesnick, 1978
Lebowitz, 1976
Lieblich, 1978
Miller, R., 1975
(New York), 1978a
Pendleton, 1975, 1976
Quadling, 1975
Quinn, 1976
Rogers, J. J., 1976
Rosenblum, 1977
Shin, 1978

Pros/cons (continued)

Shumway, 1976
Stolovich, 1976
Suydam, 1976a, b, 1977
Swartz, 1976
Wavrik, 1978d
Webb, 1976
Yates, 1977a
Young, 1978

Rational numbers

Berkowitz, 1973
Billstein and Lott, 1978
de Cortex, 1976
Gaslin, 1972, 1975
Hobbs and Burris, 1978
Jamski, 1977, 1979

Ratios

Szetela, 1978a, b
Zepp, 1976

Reciprocals

Friedlander, 1978
Miller and Hazekamp, 1978
Priest, 1973
Simons, 1977
Willson, 1978a

Recommendations

Aidala, 1978
Bell, M., 1974
Bell, M., 1976
Bell, M., 1977
Bormann, 1973
Hill, 1976
(Indiana), 1977
Munson, 1977
NACOME, 1975
NCTM, 1974, 1976a, b, 1978
(New York), 1978b
NIE, 1975
NIE/NSF, 1977
Rising, 1979
Wheatley, G., 1979

References (selected)

Giese, 1978a, b
Goodson, 1978b
Grinstein, 1978
Heilman, 1975
Joneson, 1978
Meissner, 1976a, 1978c, 1979a, b
NCTM, -

Remedial

Aldridge, 1977
Bitter and Nelson, 1975
Bourjaily and Radachy, 1977
Fritz, 1975
Gooden, 1978
Jewell, 1979b
Kastner, 1975
Kolpas, 1978
Leitzel and Waits, 1976
Nelson, 1976
(New York), - , 1978b
Posamentier, 1975
(Sharp), 1972
Wheatley, C., 1979

Research

Advani, 1972
Aldridge, 1977
Allen, 1976
Andersen, 1977
Ayers, 1977, 1979
Beardslee, 1977
Beck, 1960
Bell, A. et al., 1978
Bell, M., 1977
Bell, M. et al., 1977
Betts, 1937
Bitter and Nelson, 1975
Blume and Michell, 1979
Bolesky, 1977
Boling, 1977
Borden, 1977
Bosley, 1978
Broussard et al., 1969
Buchman, 1969
Bukowski, 1975
Burger, 1974
Campbell and Virgin, 1976a, b
Capoferi, 1977

Research (continued)

Capoferi and Winowski, 1975
Capoferi et al., 1976
Cech, 1970, 1972
Channell, 1978
Chasson, 1977
Cooper, A., 1978
Coward, 1978
D'Ambrosio,-
de Cortex, 1976
Downes et al., 1977
(Durham), 1976
Durrance, 1965
Dyce, 1978
Eckmier, 1978
Ellis and Corum, 1969
Ethelberg-Laursen, 1978
Fehr et al., 1956
Fesharaki, 1979
Findley, 1967
Fischman, 1976
Gallery, 1978
Gaslin, 1972, 1975
Geisinger and Roberts, 1978
Gooden, 1978
Graeber et al., 1977
Grosswirth, 1975
Hawthorne and Sullivan, 1975
Hector, 1979
Hemer, 1977
Hohlfeld, 1974
Hopkins, B., 1978
Huffman, 1977
Hutton, 1977, 1978a
Jamski, 1977, 1979
Jewell, 1979a
Johnson, R., 1971
Jones, E., 1976
Kasnic, 1978
Kastner, 1975
Kelley and Lansing, 1975
Keough and Burke, 1969
Kessner, 1975
Kissler et al., 1978
Klimas, 1979
Kobrin, 1978
Koller and Mulhern, 1977a, b
Kolpas, 1978
Koop, 1978
Kruse and Burkett, 1977
Ladd, 1974
Laursen, 1978

Research (continued)

Lawson, 1978
Lenhard, 1977
Likens, 1977
Lim and Tseng, 1976, 1977
Longstaff et al., 1968
Lowerre et al., 1978
Lowry, 1977
Lunder, 1979
Luxton and Spungin, 1976
Majumdar, 1977
Mason, 1979
Mastbaum, 1969
Mcanelly, 1978
McLeod and Adams, 1979
Miller, D. P., 1977
Moser, 1979
Muzeroll, 1976
NAEP, 1978
Neill, 1977, 1978, 1979
Nelson, 1976
Nichols, 1976
NIE/NSF, 1977
O'Loughlin, 1976
Palmer, 1978
Papritan, 1978
Parks, 1977
Peterson and Capoferi, 1976
(Philadelphia), 1975a, b
Prigge and Langemo, 1978
Quinn, 1976
Rising, 1979
Roberts and Fabrey, 1977, 1978
Roberts and Glynn, 1976, 1977,
1978a, b, 1979
Roberts and Lerner, 1978
Roberts et al., 1978
Royce and Shank, 1977
Rudnick, 1978
Rudnick and Krulik, 1976
Scandura, 1976, 1978
Schafer et al., 1975
Schnur and Lang, 1976
Schott, 1955
(Sharp), 1972
Shea, 1974
Shin, 1978
Shirey, 1976
Shuch, 1976
Shumway, 1979
Shumway et al., 1979
Smith, B., 1978

Research (continued)

SMP, 1977
Sosebee and Walsh, 1975
Spencer, 1975
Stocks, 1972
Sutherland, 1977
Suydam, 1976a, 1979
Szetela, 1978a, b; 1979
Szetela and Campbell, 1978a, b
Tashjian, 1977
Toole, 1979
Triggs, 1966
Vaughn, 1977
Wajeih, 1976
Ward, 1979
Weaver, 1976a, b
Weiss, 1978
Whitaker, 1977
Williams, 1979
Williams and Tobin, 1978
Williams and Jones, 1979
Wilson, A., 1978
Yvon and Downing, 1978
Zepp, 1976

Roles

Arens et al., 1978
Beare, 1977a, b
Bell, F., 1978
Bell, M., 1977
Bell, M., 1978
Bitter, 1977a
Bitter and Metos, 1977
Blakeley, 1978
Brasel, 1977
Bristol, 1978
Brown, K., 1978
Buckwalter, 1973, 1975b
Butler, 1978
Cantor, 1974
Caravella, 1977b
Carney, 1978
Clarke, J., 1971
Curtis, 1977
D'Ambrosio, 1977, 1978a, b
D'Ambrosio, -
D'Aulaire and D'Aulaire, 1975
Del Seni, 1975
Denman, 1974
(Durham), 1976
Edsall et al., 1976

Roles (continued)

Elder, 1975
Engel, 1975, 1978
Etlinger, 1974
Favre, 1978
Feder, 1975
Fielker, 1973
Free, 1975
Gawronski and Coblenz, 1976
Gibb, 1975a, b
Giese, 1978a, b
Girling, 1977, 1978
Graeber et al., 1977
Haberman and Berstein, 1975
Hamada, 1978
Hannon, 1973
Hatfield, 1978a, b
Hawthorne, 1973
Hemer, 1977
Herget et al., 1978
Herron, 1977
Hiatt, 1977
Hickey, 1970
Higgins, 1974
Hill, 1976
Hoffman, 1975
Holmes, 1978
Hopkins, E., 1976
Immerzeel, 1976a, b, c
(Indiana), 1977
Jennings and Towns, 1978
Johnson, D., 1978
Judd, 1975a
Kaufman and Haag, 1977
Kibler and Campbell, 1976
Kitchen, 1971
Kruse and Burkett, 1977
Lazarus, 1978
Lewis, G., 1977
Lewis, J., 1975b
Lewis, P., 1974
Lindsay, 1975, 1977
Machlowitz, 1976
Maier, 1977
Maindonald, 1978
Mansilla, 1977
McCluggage, 1973
McKellips, 1974
McWilliam, 1974
Meissner, 1977e;
(Michigan), 1977
Miller, D. I., 1974
Muller, R., 1973

Roles (continued)

Mims, 1977
(Minneapolis), 1976-77
Moursund, 1977a, b, c, 1978
Munson, 1977
Myrick, 1975
NACOME, 1975
NCTM, 1976a, b
(New York), - , 1978b
NIE, 1975
NIE/NSF, 1977
North, 1975
Osborne, 1974
Parks, 1975
Pollak, 1977
Quadling, 1975
Quinn, M., 1974
Reeves, 1975
Reynolds, 1976
Rising, 1979
Russell, 1977
Schmalz, 1978
Schmitt, 1976
(Shell), 1977
Sinha, 1977
SMP, 1977
Stein, 1976
Stephens, 1978
Taylor, 1976
Teitelbaum, 1978
Troutman and Lichtenberg, 1977
Usiskin, 1978
Utterback, 1975
Vieules, 1979
Wasson, 1972
Weaver, 1977c
Weldert, 1977
Werner, 1978
Wheatley, G., 1979
Winkelmann, 1978
Wynands, 1978
Wynands and Wynands, 1978
Yates, 1977b

Roots

Bravin, 1973
D'Ambrosio,
Egbert, 1977a
Eimer, 1977
Ferguson, 1978

Roots (continued)

French, 1977
Hutton, 1977
Johnston, 1978b
Leaton, 1975
McCarty, 1978
Miller and Hazekamp, 1978
Priest, 1973
Reubens, 1978
Scott, 1978a
Vincent, 1976
Waits, 1978a
Willson, 1976, 1978b
Yee, 1978

Science

Beare, 1977a, b
DeJong, 1975
Eisberg and Hyde,-
Forbes, 1978
Jamski, 1978
Kitchen, 1971
Lewis, J., 1975b, 1977b
Sandery, 1974
Schmidt, 1977
Shearer, 1976

Scientific calculators

Ball, 1977
Budlong, 1972
Crothamel, 1978
Hyatt and Feldman, 1979
Lewis, J., 1974, 1975a, b
Meyer, 1975
Noll, 1976a, b, c, 1977
(Texas Instruments), 1976c

Secondary

Advani, 1972
Averett et al., 1977
Aviv, 1979
Bahe, 1974
Beare, 1977a, b
Bell, M. et al., 1977
Blume and Mitchell, 1979
Bolesky, 1977

Secondary (continued)

Boling, 1977
Bourjaily and Radachy, 1977
Boyle, 1976
Brown, L., 1976
Buchman, 1969
Carney, 1978
Cech, 1970, 1972
Clarke, J., 1971
Crothamel, 1978
D'Ambrosio, -
Dubisch and Hood, 1979
Dunlop, 1978
(Durham), 1976
Edsall, 1978
Ellis and Corum, 1969
Engel, 1974
Fielker, 1976a, b
Findley, 1967
Fischman, 1976
Fritz, 1975
Gallery, 1978
Gaslin, 1972, 1975
Hemer, 1977
Henry, L., 1977
Herron, 1977
Hiatt, 1977
Hoffmann, 1977
Holdsworth, 1977b
Hopkins, B., 1978
Huffman, 1977
Humphreys et al., 1977
Hutton, 1977
Jansson, 1978
Jennings and Towns, 1978
Jewell, 1979a
Kastner, 1975
Keller, 1978
Keough and Burke, 1969
Kolpas, 1978
Ladd, 1974, 1976
Laursen, 1978
Lawson, 1978
Lenhard, 1977
Lewis, J., 1977a
Lipsey, 1978
Longstaff et al., 1968
Lunder, 1979
Luxton and Spungin, 1976
Marshall and Hussey, 1978
McCready, 1972, 1977
Meissner, 1977f

Secondary (continued)

(Michigan), 1977
Miller, D., 1977, 1979
Miller and Hazekamp, 1978
(Minneapolis), 1976-77
NACOME, 1975
Neill, 1977, 1978, 1979
(New York), 1978a
North, 1975
Papritan, 1978
Parks, 1977
Peterson and Capoferi, 1976
(Philadelphia), 1975b
Pollak, 1977
Posamentier, 1975
Priest, 1973
Rade, 1977
Rade and Kaufman, 1976, 1977
Rees et al., 1978
Riden, 1975
Rising et al., 1978
Robinson, 1976, 1977
Russakoff, 1979
Schmitt, 1976
Shirey, 1976
Simons, 1977
Smith, C., 1976
Smith, S., 1978
Snover and Spikell, 1978, 1979e, f
Stover, 1977
Summers, 1978b
Szetela, 1979
Szetela and Campbell, 1978a, b
Taylor, 1976
(Texas Instruments), 1976c, 1977f, g
Toole, 1979
Vail, 1974
Vaughn, 1977
Vine, 1975
Waits, 1977
Wajeeth, 1976
Ward, 1979
Wasson, 1972
Webb, 1976
Weiss, 1978
Weldert, 1977
Whatham, 1977
Wilderman, 1977
Williams, 1979
Williams and Tobin, 1978
Williams and Jones, 1979
Willson, 1976

Secondary (continued)

Woodburn, 1976
Yvon and Downing, 1978
Zepp, 1976

Selection

Asmus, 1972
Ciallotto, 1972a, b
Beakly and Leach, 1975
Beare, 1977c
Berger, 1973, 1974, 1975
Birtwhistle, 1974
Bitter, 1978
Blodgett, 1976
Bormann, 1973
Buckwalter, 1975b
Budlong, 1972
Capoferi, 1977
Caravella, 1976a, b, 1977a, b
Clark and Barandes, 1977
Comarow, 1974, 1975
Consumer Bulletin, 1972, 1973
Consumer Reports, 1973-1977
Consumer's Research, 1974-1978
D'Aulaire and D'Aulaire, 1975
Deeson, 1974
Dohleman, 1973
(Durham), 1976
Ewing, 1975
Fielker, 1973, 1976b
Free, 1973, 1975, 1976, 1977a, b,
1979
Frye, 1974, 1975
Gibb, 1975b
Goodrich et al., 1977
Gottheimer, 1978
Haigh, 1979
Hardcast, 1974
(Hewlett-Packard), 1976a, b
Higgins, 1978
Jamele, 1975
Janota, 1977
Jesson and Kurley, 1975, 1976
Judd, 1975a
Karp, 1975a, b
Kinzey, 1975
LaBar et al., 1974
Lachenbruch, 1978
Lander, 1978
Lavoie, 1968, 1972

Selection (continued)

Lewis, J., 1974, 1975a, b, 1977a
Lewis, P., 1974
Locke, 1978
Lorthup and Jones, 1975
Machlowitz, 1976
Madison and Frotar, 1978
McCarthy, 1977
Meissner, 1977a, 1977b, 1977d
Mims, 1974, 1976
NCTM, -, -
New, 1977a, b
Osofsky, 1976
Pederson and Sharrah, 1979
Roberts, H., 1974
Rosenblum, 1977
Shaw, 1973
Sippl, 1976a, b
Thornton, 1976
Tobin and Eib, 1978
Valery, 1976
Walton, 1978
Weaver, P., 1976

Significant figures

Satek, 1977

Slide rule

Braun, 1976
Field, 1977
Johnston, 1976

Solution methods

Blume and Mitchell, 1979

Statistics

Ayers, 1977, 1979
Coons, 1978
Crothamel, 1978
Geisinger and Roberts, 1978
Johnston, 1978c
King, 1978
Kissane, 1978
Kissler et al., 1978

Statistics (continued)

Roberts and Fabrey, 1977, 1978
Roberts and Glynn, 1976, 1977,
1978a, b, 1979
Roberts and Lerner, 1978
Roberts et al., 1978
Vincent, 1976
Wolfe, 1978

Status report

Bell, M. et al., 1977
Caravella, 1977b

Subtraction

Koller and Mulhern, 1977a, b
Weaver, 1976b

Teachers

Beardslee, 1977
Billstein and Lott, 1978
Bitter et al., 1977
Campbell and Virgin, 1976b
Cox, 1977
Frandsen, 1976
Graeber et al., 1977
Hoffmann, 1977
Huffman, 1977
Kreinberg, 1978
Lowry, 1977
McLeod and Adams, 1979
Moursund, 1977a, b
(North Carolina), 1978
Palmer, 1978
(Philadelphia), 1975b
Williams and Tobin, 1978
Williams and Jones, 1979

Technical mathematics

Hyatt et al., 1979

Technical occupations

Fitzgerald, 1976

Testing

Craver, 1976
Fielker, 1976
Kolpas, 1978
Lewis, J., 1977b
Lunder, 1979
NAEP, 1978
Sosebee and Walsh, 1975
Watson, 1978
Weldert, 1977
Williams and Jones, 1979

Time

Kahn, 1976
Moser, 1979
Peters, 1977
Scott, 1978b
Tyler, T., 1975

Trigonometry

DeJong, 1975
Egbert, 1977b, c
Harkin, 1978
Spero, 1977
Szetela, 1979
Szetela and Campbell, 1978a, b
Willson, 1976

Units

Billstein and Lott, 1978
Borden, 1977
Carney, 1978
Gallery, 1978
Gaslin, 1972, 1975
Hoffmann, 1977
Hopkins, B., 1978
Hutton, 1977, 1978a
(Iowa), 1978
Johnson, R., 1971
Millikin and Siegel, 1970
Nebel, 1977
Oswald, 1978
Papy, 1977
Roberts, J. B., 1978
(Texas Instruments), 1977e, f, g

Units (continued)

Wavrik, 1978f, g
Weaver, 1977a, b; 1978a, b
Whatham, 1977
Wilderman, 1977

Vocational agriculture

Papritan, 1978

Worksheets

Adkins, 1977
Albrecht, 1977-1978
Billings and Moursund, 1978a, b, c, d
Billstein and Lott, 1978
Bitter, 1977b
Bright, 1978
Clyde, 1978
Cox, 1977
Davidson, 1976, 1978
Gilbreath et al., 1978
Goodhue, 1978
Goodson, 1978a
Haigh, 1978
Hiatt, 1977
Humphreys et al., 1977
(Iowa), 1975a, b, c
Jamski, 1979b
Jurgensen, 1978
Ladd, 1976
Lloyd, 1978
Miller and Hazekamp, 1978
Ockenga and Duea, 1978
Prigge and Mauland, 1978
Reys et al., 1979
Robinson, 1976
Schmalz, 1978
Schoen, 1979
Smith, S., 1978
Stephen and Trueman, 1977
Vervoort and Mason, 1977
Woodburn, 1976

Australia

Holdsworth, 1977a, b
Kissane, 1979
Sandery, 1974
Smith, 1976
Stephens, 1978
Whatham, 1977
Calculators ..., 1978
Electronic ..., 1978
Some Guidelines, 1978
Some Proposals, 1978

Brazil

D'Ambrosio, 1977, 1978, +
de Cortex, 1976
DeQuetroz, 1977
Ferreira, 1977
Mansilla, 1977
Mortari and Polidoro, -
Relatorio ..., 1975
5° Conferencia, 1979

England

Austin, 1979
Babani, 1978
Bawtree, 1979
Beare, 1977
Beare and New, 1977
Bell et al., 1978
Birtwhistle, 1974, 1977, 1978
Blakely, 1978, 1979
Clarke, 1971
Cooper, 1976
Coward, 1978
(Durham), 1976
Edsall et al., 1976
Ethelberg-Laursen, 1978
Ferguson, 1978
Fielker, 1973, 1976a, b
Fitzgerald, 1976
Fletcher, 1976
French, 1977
Girling, 1977
Goult, 1977
Haigh, 1978, 1979
Hale, 1974
Jansson, 1978
Johnson, 1978

England (continued)

Knowles, 1979
Leaton, 1975
Lewis, 1974, 1975a, b, 1977a, b
Lindsay, R., 1975
Lindsay, I., 1977
Mendoza, 1975
Neill, 1978
New, 1977a, b
North, 1975
Ounsted, 1978
Pallister, 1977
Quadling, 1975
Reynolds, 1976
Russell, 1977
Shaw, 1973
Summers, 1978
Triggs, 1966
Turnbull et al., 1977
Tyler, 1977
Vine, 1978
Webb, 1976
Willson, 1976, 1978a, b
An Impression ..., 1976
Apparatus ..., 1977
Electronic ..., 1977
A Guide ..., 1978
Science ..., 1977
Shell ..., 1977
SMP, 1977

France

Valery, 1976
Vieules, 1979

Ireland

McCarthy, 1977

Israel

Hoffmann, 1977
Zwas and Brauer, 1975

Luxembourg

Favre, 1978

Netherlands

Elektronisch ..., 1976

New Zealand

Angus, 1978
Butler, 1978
Clarke, J., 1978
Clarke, R., 1978
Jennings and Towns, 1978
Lloyd, 1978
Maindonald, 1978
Activity ..., 1978
Calculators ..., 1978

South Africa

Edsall, 1978
Girling, 1978
Watson, 1978a, b
Calculators ..., 1978
Calculators ..., 1978

Sweden

Hemer, 1977

West Germany

Arens et al., 1978
Engel, 1975, 1978
Herget et al., 1978
Meissner, 1976 (2), 1977 (7),
1978 (5), 1979 (2), + (2)
Meissner et al., -
Schmitt, 1976
Sieber et al., 1977
Winkelmann, 1978
Wynands, 1978
Wynands and Wynands, 1976